THESIS/
REPORTS
PLATTS, W.S.

MARCH 1972

AQUATIC ENVIRONMENT AND FISHERIES STUDY

BOULDER AND PIONEER MOUNTAIN AREAS

William S. Platts

AEFA005358

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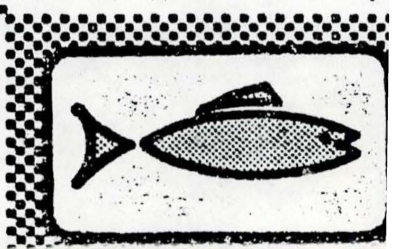

AQUATIC ENVIRONMENT AND FISHERIES STUDY

BOULDER AND PIONEER MOUNTAIN AREAS

by

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U. S. D. A. - Forest Service - Intermountain Region

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March 1972

Note: This report is an addendum to the main report, "Aquatic Environment and Fisheries Study Within the Proposed Sawtooth National Recreation and Wilderness Areas, Idaho," January 1972. This report covers those areas that lie outside the proposed Sawtooth National Recreation Area, but within the White Cloud-Boulder-Pioneer Study Area.

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INTRODUCTION

The Boulder-Pioneer Areas contain a resident fishery only, while the White Cloud Area contains both an anadromous and resident fishery. The White Cloud Area anadromous fishery is composed of spring and summer chinook, sockeye salmon (which only pass through), steelhead, plus the nongame fish, lamprey. The anadromous species have declined drastically within the area due to both downriver (lower Snake and Columbia) and upriver degraded conditions.

The resident fishery is found in both the lake and stream environments. Some of the resident stream fisheries have declined (cutthroat and rainbow), while the lake-dwelling game fish have increased as a result of management programs by the Idaho Fish and Game Department. A large portion of the rainbow trout harvested from the area is from hatchery stocks.

Native game fish in the three areas now consist of cutthroat, Dolly Varden, rainbow, and steelhead trout; kokanee, sockeye, and chinook salmon; and whitefish. Introduced game fish species include brook trout, California golden trout, and grayling. Nongame species include squawfish, suckers, redside shiner, dace, chiselmouth chub, lamprey, and sculpin.

Rainbow trout, due partly to artificial supplement, are probably the most numerous fish entering the creel. Whitefish are quite numerous, but are not highly desired by the fisherman. Cutthroat trout appear throughout the area, but are harvested mainly in the high mountain lakes. Fluvial

cutthroat trout have been reduced from past numbers and their status needs to be evaluated. Grayling are just being established and will, in the future, help provide more diversity to the recreationst. California golden trout are lower in numbers than in past years but are presently being introduced.

The stream fishing success or desirability for fishing is determined to a large extent by stream condition. During high flows, the streams are sometimes inaccessible and velocities usually make fishing success very low and undesirable. During normal base flows, fishing conditions are much more optimum. Usually, by mid-July, good fishing conditions have developed which last until freezeup in October or November. The short, ice-free conditions make the available fishing period very short in the majority of the area. A fundamental characteristic of high elevation waters is the relatively short summer season, while over the rest of the year generally severe conditions prevail with low temperatures, floods, ice, and snow. Snowslides or long periods of deep snow cover can completely kill out a fish population in small streams, shallower lakes, and, on some occasions, in deeper lakes--thus making the lake or stream barren. A well-populated lake one year may be a desert the next year as far as fish life is concerned.

Climatic conditions change from year to year so that there is great variability in the processes acting upon the environment. Some shallow lakes in the study area are marginal and may support fish for several years until a severe winter depletes the oxygen supply or displaces the

water. However, many lakes with depths of only 4 to 5 feet (especially in the Pioneer Area) in depth are able to support continuous fishing, as they have constant inflow, seepage, or upwelling. Thus, the fishing of the high country can be a guessing game to the fishermen due to climatic influences. Also, many of the lakes and streams have not been studied or managed to the point that fisheries can be determined, predicted, or governed.

Fishing within these esthetic waters is a very rewarding experience and much sought after by the recreationist. This experience is the prime area of importance to consider in outlining a management plan so optimization of this experience will be available to the recreationist. Also, many recreationists may just enjoy seeing cutthroat trout swimming in a crystal clear, high elevation tarn lake, or observe brook trout rising in a beaver dam located in a high basin meadow, or watch salmon spawning on a gravel bar in the lower river area, or witness stealhead trout work their way up a small tributary. This is not direct participation or a consumptive use of the fishery, but because of its importance as an experience, it must be considered in the overall management of the aquatic environment. In some areas during certain time periods, this nonconsumptive use may be of more value than the actual consumptive fishery. So we have both a nonconsumptive and consumptive type recreation experience to consider in the management plan.

PIONEER AREA

The aquatic environment-fisheries discussion is stratified by respective areas. This mainly includes only that information that does not appear

in the main report. For more complete information and interpretation, the reader should refer to the "Aquatic Environment and Fisheries Study Within the Proposed Sawtooth National Recreation and Wilderness Areas, Idaho," March 1972.

Big Lost River is the main system draining the Pioneer Area and is rated as one of the better fisheries in Idaho. It is unique in that it does not contain many of the nongame fish found in most other drainages, but almost exclusively salmonids with a few species of forage fish. This is because the drainage sinks in the lava flows and thus does not have contact with downstream drainages. It is a self-contained unit. It is a fertile drainage with an abundance of relatively low elevation, low gradient perennial flowing streams. Big Lost River supplies the water for the Mackay Reservoir fishery before continuing on to the Snake River Valley where it sinks in the desert. Thus, fish from other drainages do not have access to the main portion of the Pioneers. This has greatly enhanced the fishery, as it allows the aquatic environment to convert most of the available biomass into salmonids which are more highly demanded by the recreationist.

Lacustrine

The lakes, as in the other study areas, differ from one another due to parent materials contacting respective aquifers, lake-forming processes, size and type of watershed, ability of aquifers to hold and discharge water, size of inlets, etc.

Many of the Pioneer lakes are not producing a fishery at the present time because of limiting factors or no recent stocking. Most of the lakes not supporting fisheries can be keyed to low heat budget and low amounts of dissolved oxygen during winter months. Like some of the lakes studied in the other areas, a few of them lend themselves to be placed in a more stable fishery or to change from a nonexistent to a newly developed fishery.

Golden Lake, at one time, supported California golden trout, but they passed out of existence in the late 1950's. It was restocked again with "golden" in 1970. Due to lack of inlets and shoreline permeable gravels, this lake may not propagate "goldens" without artificial supplementation. A lake is needed for "goldens" to give the recreationist some variability in their fishing. Grayling have recently been stocked (1970) in Round Lake, which contains good conditioned rainbow trout. This lake has poor inlet and outlet spawning conditions, but may produce shoal spawning. It would be very beneficial to have grayling in one of the lakes due to their uniqueness which adds variety to the fisherman's experience.

Bellas Creek Drainage. The Bellas Lakes (tables 2 and 5) have become very popular due in part to their ability to produce large, good conditioned trout, but also because the main Bellas Lake at one time contained mainly California golden trout. At one time, this stock was used as an egg supply for other lakes in Idaho. Stocking of cutthroat trout has almost eliminated the "golden" population.

Table 1 Fish Stocking Records from 1965 to 1970
for the Boulder-Pioneer High Mountain Lakes

Lake	1965	1966	1967	1968	1969	1970	Totals
(Big Wood Area)							
Baker			CT 3,060		CT 2,829		CT 5,889
Little Lost			CT 1,020		CT 1,435		CT 2,455
Big Lost			CT 3,060		CT 2,829		CT 5,889
					GR 1,900		GR 1,900
Hidden	CT 950				CT 943		CT 1,893
Mill							
Norton #1	CT 2,850		CT 3,060		RB 1,840		CT 5,910
							RB 1,840
Norton #2	CT 1,800		CT 3,060		RB 1,840		RB 1,840
							CT 4,860
Prairie	RB 1,800		CT 3,060		RB 1,840		RB 3,640
							CT 3,060
Titus			CT 1,530		CT 1,435		CT 2,965
(Copper Basin Area)							
Angel	RB 2,400	CT 1,012					RB 2,400
							CT 1,012
Airplane	RB 2,400	CT 1,012			RB 920		RB 3,320
							CT 1,012
Arrowhead	RB 2,400	CT 1,012			RB 920		RB 3,320
							CT 1,012
Baptie	CT 2,850		CT 2,048		CT 920		CT 5,818
Betty	CT 2,850		CT 1,536		CT 2,760		CT 7,146
Bench	CT 1,425		CT 1,536		CT 920		CT 3,881
Bellas #1	CT 1,425						CT 1,425
Bellas #2	CT 1,425			RB 1,264			RB 1,264
							CT 1,425
Bellas No. Fk.			CT 1,536				CT 1,536
Big				RB 2,212		RB 3,000	RB 5,212
Big Fall			RB 1,470		RB 920		RB 2,390
Bobber	CT 875			CT 1,000		CT 1,000	CT 2,875
Box Canyon #1			RB 2,520			CT 1,000	RB 2,520
							CT 1,000
Box Canyon #2							
Boulder	RB 1,200		RB 980		RB 1,840		RB 4,020
Brookie					CT 920		CT 920
Clear	CT 1,425		CT 1,536		CT 920		CT 3,881
Corral Creek					CT 920		CT 920
Fish Pole	CT 1,750			CT 2,000		CT 2,000	CT 5,750
Grant Creek							
Goat	CT 2,850		CT 3,072		CT 1,840		CT 7,762
Green				RB 2,212		RB 2,000	RB 4,212
Golden				RB 632		CG 200	RB 632
							CG 200
Iron Bog	CT 2,187			CT 3,000		CT 3,000	CT 8,187
Kane	CT 2,014		CT 2,048		CT 2,760		CT 6,822
Long	CT 3,036			RB 2,212		RB 3,000	RB 5,212
							CT 3,036
Moose				RB 1,264			RB 1,264
Nip-n-Tuck	CT 2,850		CT 2,048			CT 2,000	CT 6,898
Rough	CT 3,036		CT 800	CT 1,000		CT 3,000	CT 7,836
Round	CT 3,036			RB 2,843	GR 950	GR 2,800	CT 3,036
						RB 2,000	RB 4,843
							GR 3,750
Star Hope	CT 1,875			CT 2,000	GR 2,100	CT 1,000	CT 4,875
						GR 2,800	GR 4,900
Surprise Valley							
Washington	RB 600		CT 490		RB 920		RB 1,520
							CT 490
Windy	CT 2,850		CT 3,072			CT 2,000	CT 7,922
Wildhorse					CO 1,000		CO 1,000
Totals CT	43,359	3,036	37,572	9,000	21,431	15,000	129,398
RB	10,800		4,970	12,639	11,040	10,000	49,449
GR					4,950	5,600	10,550
CO					1,000	200	1,200

CT = Cutthroat GR= Grayling
RB = Rainbow CG= Golden

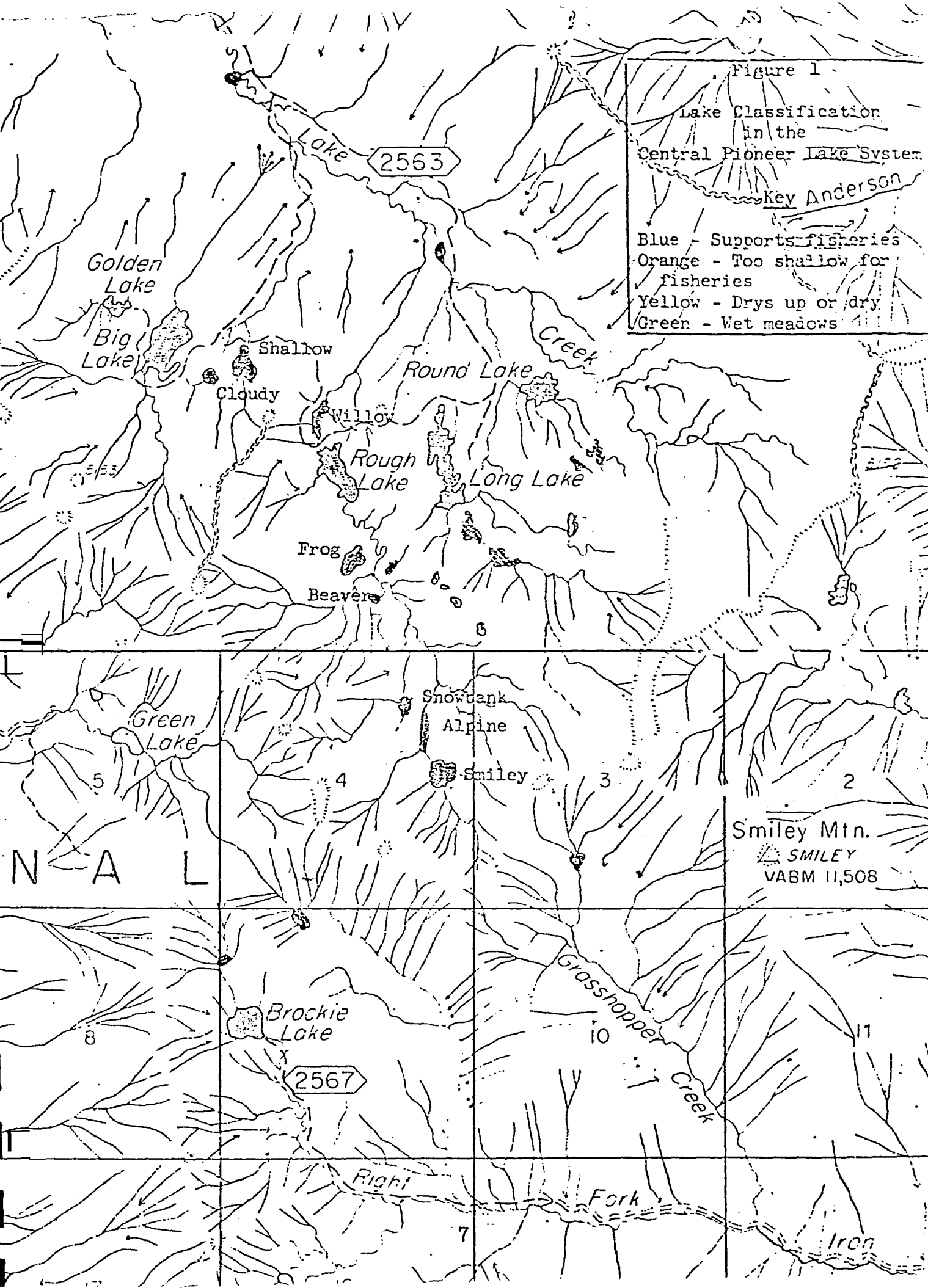


Figure 1
Lake Classification
in the
Central Pioneer Lake System
Key Anderson
Blue - Supports fisheries
Orange - Too shallow for fisheries
Yellow - Drys up or dry
Green - Wet meadows
Lake
2563
Golden Lake
Big Lake
Shallow
Cloudy
Willow
Round Lake
Creek
Rough Lake
Long Lake
Frog
Beaver
Green Lake
Snowbank
Alpine
Smiley
Smiley Mtn.
SMILEY
VABM 11,508
Brockie Lake
2567
Grasshopper Creek
Right
Fork
Iron

Broad Canyon Drainage. The lakes in this drainage (tables 3 and 5), due to heavier glaciation and good fertility, contain some of the better lakes in the Pioneers. Baptie, Goat, and Betty are all capable of producing 2- to 10-pound trout if stocked numbers and time periods between stocking are closely controlled. Of course, fishing pressure also enters in.

Wildhorse Drainage. Many of the lakes in this drainage are quite shallow and cannot carry fish during critical winter conditions. Exceptions to this are Angle and Moose Lakes which support good fisheries. Under controlled stocking numbers and fishing pressure, Angle Lake is capable of producing 12- to 16-inch trout annually.

Some lakes in this area could possibly benefit from additional inlet stream area access for fish spawning and rearing. In some lakes, the steep gradient, low flows, or other types of migration blocks eliminate or restrict fish access for spawning purposes. However, the Idaho Fish and Game Department has lake stocking down to a minimum cost (about $7 per lake) and, in many cases, it is better to have control of the population numbers so control of size and condition is possible. In lakes being managed for California golden, grayling, sunapee golden, or brook trout, stream inlet access or shoreline spawning materials could be critical to continual survival.

Lake Creek Drainage. This drainage has about 15 lakes (tables 4 and 5) which are quite shallow. Only five of them are supporting fisheries at the present time. The waters are fertile, and those lakes that do

support a fishery grow well-conditioned trout. All lakes in this drainage supporting a fishery receive heavy fishery pressure. Even some lakes not capable of supporting a fishery receive considerable fishing pressure due to the participants not being knowledgeable as to which lakes do support a fishery. Big Lake is probably the most popular and is an excellent fish producer. It has a maximum depth of 36 feet with little chance for critical snow conditions.

Lakes such as Beaver, Shallow, Willow, Meadow, and Frog offer chances to increase the productivity of the fishery resource. Those lakes supporting fisheries such as Long (maximum depth 4 feet), Rough (maximum depth 18 feet) and Round (maximum depth 8 feet) show that depths required to produce a fishery in this area are quite minimal.

Summary

The lakes in the Pioneer Area are shallow (table 6). The lake basins are located at an elevation of 9,752 feet. Evidently, climatic conditions did not allow glaciers to build up to the point that they could drastically change systems with their digging, plucking action.

Only 13 percent of the lakes surveyed were unstable and 52 percent of the lakes were supporting a fishery, but about 80 percent were incapable of producing naturally to the extent of producing a good fishery. This demonstrates the need for a continual, well-developed fish stocking program.

Table 2 Physical Conditions of the Lakes in the Bellas Canyon Drainage, Pioneer Area

Lakes	Depth Max (ft)	Depth Ave. (ft)	Elevation (ft)	Fluctuation	Natural Reprod.	Fish Species	Shoal Area	Shoal Bottom Rock	Shoal Bottom Fines	Aquatic Rooted Plants	Fish Condition	Fishery Potential
Bellas Lake No. 1	23	19.5	9,500	Stable	yes	G, C	10	30	70	None	Excellent	1
Bellas Lake No. 2	9	7	10,000	Stable	none		100	30	70	None		2
Green Lake	23	19	9,600	Stable	doubtful	R	10	40	60	None	Fair	1
West Fk. Bellas Lake	5	4	9,700	Stable	doubtful	C	100	5	95	Sparse	Good	1
Averages	15	13	9,700	Stable 100%	yes 25% dfl 50% none 25%	C 50% G 25% R 25%	55%	26%	74%	Sparse 25% None 75%	Exc. 33% Fair 33% Good 33%	1 75% 2 25%

KEY

B Brook Trout
C Cutthroat
D.V. Dolly Varden
G Golden
Gr Grayling
N.O. None observed
R Rainbow

Fishery Potential

1. Supports Fishery
2. Does not support fishery
3. Goes dry

Table 3 Physical condition of the Lakes in the Broad Canyon Drainage, Pioneer Area.

Lakes	Depth Max (ft)	Depth Ave. (ft)	Elevation (ft)	Fluctuation	Natural Reprod.	Fish Species	Shoal Area	Shoal Bottom Rock	Shoal Bottom Fines	Aquatic Rooted Plants	Fish Condition	Fishery Potential
Baptic	18	11	10,250	Stable	Doubtful	R, C	35	40	60	None	Excellent	1
Bench	12	8.5	9,600	Stable	None	C	100	20	80	None	Poor	1
Betty	80	51	10,379	Stable	Doubtful	R, C	10	20	80	None	Excellent	1
Boo	9	5	10,100	Stable	None	None	100	35	65	None	None	2
Clear	9	4	9,220	Unstable	None	None	100	50	50	Sparse	None	2
Goat	34	28	10,438	Stable	Doubtful	R, C	15	90	10	None	Excellent	1
Averages	27	18	10,000	Stable 83% Unstable 17%	Dfl 50% None 50%	C 67% None 33% R 50% Total 150%	60%	43%	57%	Sperse 17% None 83%	Exc. 50% None 33% Poor 17%	1 67% 2 33% 3 0%

KEY

B	Brook Trout
C	Cutthroat
DV	Dolly Varden
G	Golden
Gr	Grayling
N.O.	None observed
R	Rainbow

Fishery potential

1. Supports fishery
2. Does not support fishery
3. Goes dry

Table 4 Physical Condition of the Lakes in the Lake Creek Drainage, Pioneer Area

Lakes	Depth Max (ft)	Depth Ave. (ft)	Elevation (ft)	Fluctuation	Natural Reprod.	Fish Species	Shoal Area	Shoal Bottom Rock	Shoal Bottom Fines	Aquatic Rooted Plants	Fish Condition	Fishery Potential
Alpine	6	3	9,700	Stable	None	None	100	60	40	None	None	2
Beaver	3	1	9,700	Stable	None	None	100	20	80	Abundant	None	2
Big	36	23	9,700	Stable	Yes	C, R	30	30	70	Abundant	Excellent	1
Cloudy	3	1	9,600	Unstable	None	None	100	70	30	None	None	2
Frog	3	1	9,600	Stable	None	None	100	15	85	Abundant	None	2
Golden	9	5	9,750	Unstable	Possible	R, G	100	95	5	None	Good	1
Long	4	3	9,450	Stable	Possible	R, C	100	10	90	Abundant	Excellent	1
Meadow	2	½	9,700	Stable	None	None	100	10	90	None	None	2
Bough	18	12	9,600	Stable	Doubtful	R	60	20	80	Abundant	Good	1
Round	8	6	9,375	Stable	Possible	R, Gr	100	10	80	Abundant	Good	1
Shallow	5	3	9,600	Stable	None	None	100	20	80	None	None	2
Smiley	10		9,800	Stable	None	None	100	90	10	None	None	2
Snowbank	10	6	9,700	Stable	None	None	100	50	50	None	None	2
Willow	3	1	9,600	Stable	Doubtful	R	100	20	80	Abundant	Fair	1
Averages	9	5	9,600	Stable 86%	Yes 7%	C 14%	92%	37%	63%	Abundant 50%	Exc 14%	1 43%
				Unstable 14%	Pos 21%	G 7%				None 50%	Good 21%	2 57%
					Dfl 14%	Gr 7%					Fair 7%	
					None 58%	None 56%					None 58%	
						R 42%						
					Total	126%						

KEY

B	Brook Trout
C	Cutthroat
DV	Dolly Varden
G	Golden
Gr	Grayling
N.O.	None observed

Fishery Potential

1. Supports fishery
2. Does not support fishery
3. Goes dry

Table 5 Overall Physical Condition of the Lakes in the Pioneer Area

Lakes	Depth Max. (ft)	Depth Ave. (ft)	Elevation (ft)	Fluctuation	Natural Reprod.	Fish Species	Shoal Area	Shoal Bottom Rock	Shoal Bottom Fines	Aquatic Rooted Plants	Fish Condition	Fishery Potential
Alpine	6	3	9,700	Stable	None	None	100	60	40	None	None	2
Baptic	18	11	10,250	Stable	Doubtful	R, C	35	40	60	None	Excellent	1
Beaver	3	1	9,700	Stable	None	None	100	20	80	Abundant	None	2
Bellas No. 1	23	19.5	9,500	Stable	Yes	G, C	10	30	70	None	Excellent	1
Bend	12	8.5	9,600	Stable	None	C	100	20	80	None	Poor	1
Betty	80	51	10,379	Stable	Doubtful	R, C	10	20	80	None	Excellent	1
Big	36	23	9,700	Stable	Yes	C, R	30	30	70	Abundant	Excellent	1
Boo	9	5	10,100	Stable	None	None	100	35	65	None	None	2
Clear	9	4	9,220	Unstable	None	None	100	50	50	Sparse	None	2
Cloudy	3	1	9,600	Unstable	None	None	100	70	30	None	None	2
Frog	3	1	9,600	Stable	None	None	100	15	85	Abundant	None	2
Goat	34	28	10,438	Stable	Doubtful	R, C	15	90	10	None	Excellent	1
Golden	9	5	9,750	Unstable	Possible	R, G	100	95	5	None	Good	1
Green	23	19	9,600	Stable	Doubtful	R	10	40	60	None	Fair	1
Long	4	3	9,450	Stable	Possible	R, C	100	10	90	Abundant	Excellent	1
Meadow	2	½	9,700	Stable	None	None	100	10	90	None	None	2
Rough	18	12	9,600	Stable	Doubtful	R	60	20	80	Abundant	Good	1
Shallow	5	3	9,600	Stable	None	None	100	20	80	None	None	2
Smiley	10		9,800	Stable	None	None	100	90	10	None	None	2
Snowbank	10	6	9,700	Stable	None	None	100	50	50	None	None	2
West Fk.Bellas Lake	5	4	9,700	Stable	Doubtful	C	100	5	95	Sparse	Good	1
Willow	3	1	9,600	Stable	Doubtful	R	100	20	80	Abundant	Fair	1
Averages	15	10	9,752	S. 87% U. 13%	Yes 9% Pos 9% Dfl 30% None 52%	C 36% G 9% None 45% R 41% Total = 131%	77%	38%	62%	Abnt 26% Sparse 9% None 65%	Exc. 27% Good 14% Fair 9% Poor 5% None 45%	1 = 52 2 = 48 3 = 0%

KEY

B Brook Trout
C Cutthroat
DV Dolly Varden
G Golden
Gr Grayling
N.O. None observed
R Rainbow

Fishery Potential

1. Supports fishery; 2. Does not support a fishery; 3. Goes dry.

Table 6 Average Physical Condition of 23 High Mountain Lakes in the Pioneer Area

Water Depth

Average Maximum	- 15 ft.
Average Depth	- 10 ft.

Water Stability

Stable	- 87%
Slightly unstable	- 13%
Very unstable	- 0%
Complete loss of water	- 0%

Natural Reproduction

Yes	- 9%
Possible	- 9%
Doubtful	- 30%
None	- 52%

Fish Occurrence

Cutthroat trout	- 36%
Golden trout	- 9%
Rainbow trout	- 41%
Brook trout	- 0%
Dolly Varden	- 0%
Lake Barren	- 45%

Lake Shoal Area

Percent of Lake in Shoal Area	- 77%
Shoal Area with Rock Bottom	- 38%
Shoal Area with Fines	- 62%

Rooted Aquatics

None	- 65%
Sparse	- 9%
Abundant	- 26%

Fish Condition

Excellent	- 27%
Good	- 14%
Fair	- 9%
Poor	- 5%

Average Elevation 9,752 ft.

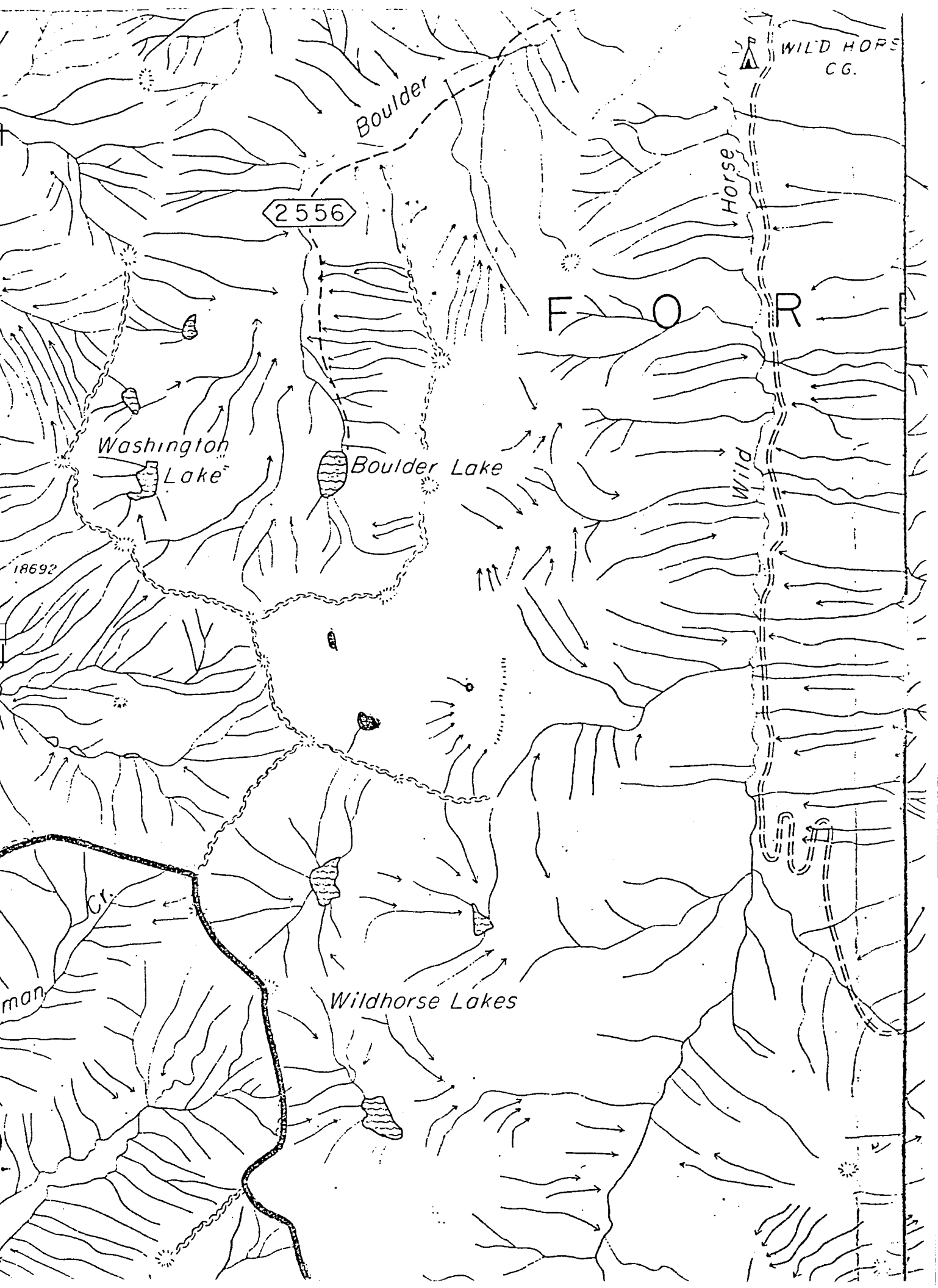
Rainbow and cutthroat trout are the dominant species and produce good fishing even though some of the lakes are very shallow. The majority of the lakes are producing good to excellent condition trout. Grayling have been recently stocked to provide more diversity to the fisherman.

At present, the majority of the lakes are not accessible for stocking with land motorized fish stocking equipment. As a result, the Idaho Fish and Game Department does the needed stocking mainly with the use of helicopters and straight-wing airplanes. At present, these methods of stocking have provided excellent fishing for the number of fishermen entering the study areas. An attempt is made to stock some of the more heavily fished, lower elevation lakes and streams every year. Many of the higher elevation lakes are stocked every 3 years. Higher elevation streams are mainly stocked through natural reproduction. The ability of these lakes to produce a fishery is very dependent on the stocking program. The most feasible and economic way to stock these waters is with the use of helicopters and fixed-wing planes. The use of this type of stocking should be worked directly into the management plans.

Some lakes do not produce because they lack sufficient depth or sufficient incoming waters. In some cases, the water levels in these lakes can possibly be raised placing them back into production.

Fluvial Environment

Very little has been done in the Pioneer Area concerning fishery fluvial aquatic environment studies. Thus, it is not possible to characterize the streams. This is especially true on the biological portion. Due to lack of monies and expertise manpower, no biological work other than fish and related food organisms have been studied.


WILD HORSE
C.G.
Boulder
2556
Horse
F O R
Washington
Lake
Boulder Lake
Wild
18692
Cr.
Wildhorse Lakes

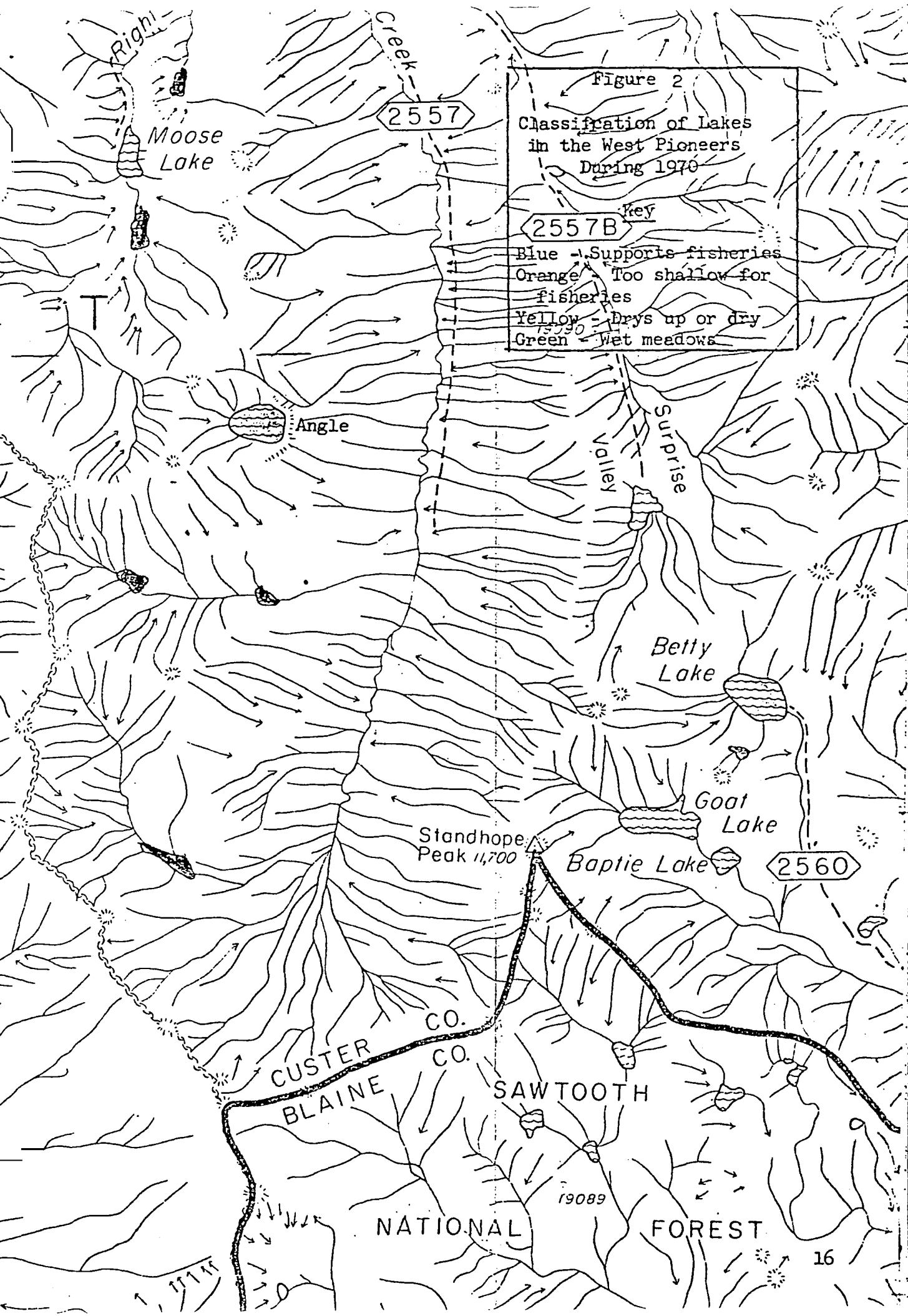
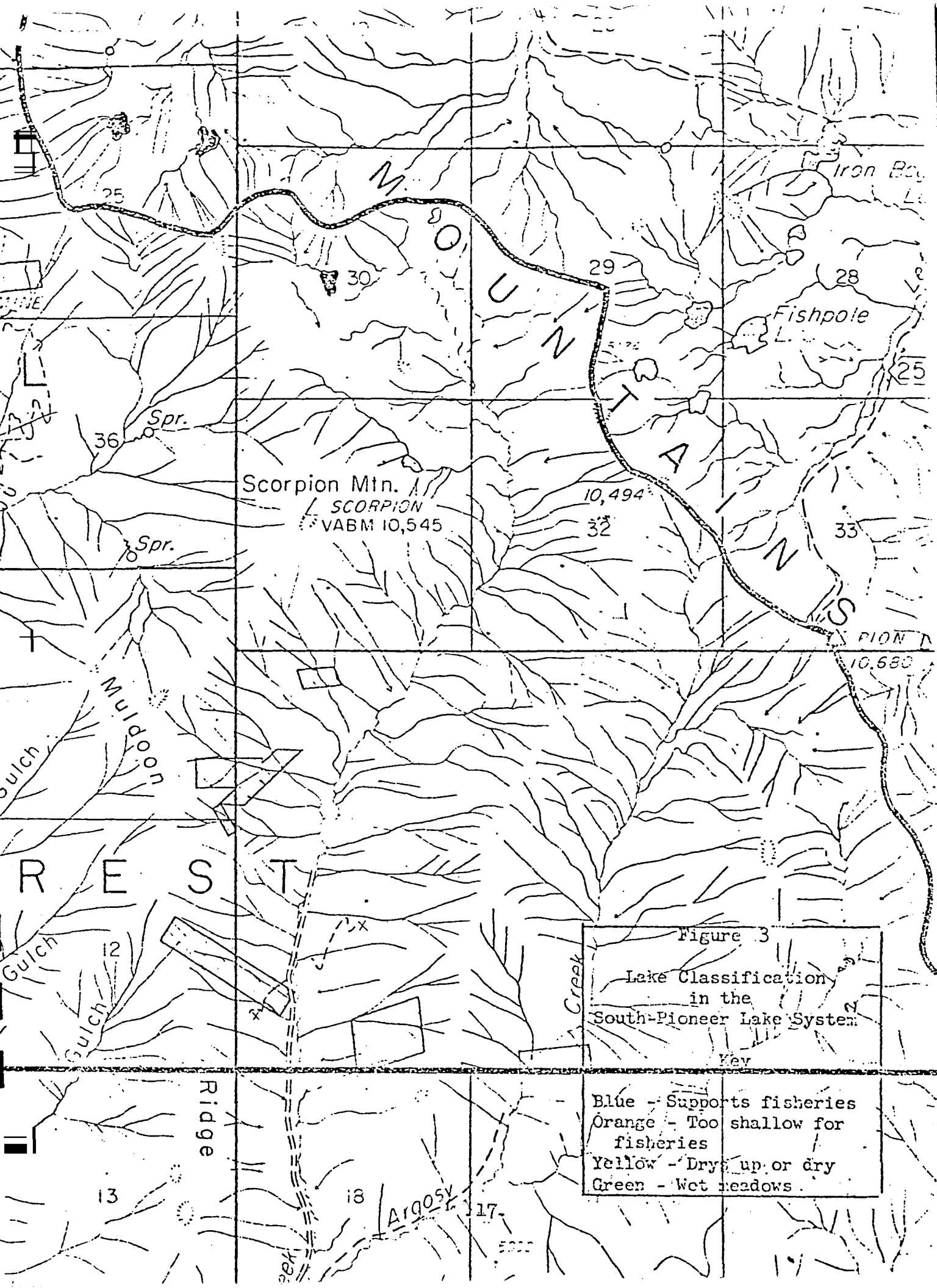


Figure 2
Classification of Lakes in the West Pioneers During 1970
Key
2557B
Blue - Supports fisheries
Orange - Too shallow for fisheries
Yellow - Drys up or dry
Green - Wet meadows
Right
Creek
2557
Moose Lake
Angle
Surprise Valley
Betty Lake
Goat Lake
Standhope Peak 11,700
Baptie Lake
2560
CUSTER CO.
BLAINE CO.
SAWTOOTH
NATIONAL FOREST


MOUNTAINS
Iron Bo
Fishpole
Scorpion Mtn.
SCORPION
VABM 10,545
10,494
10,680
Spr.
Spr.
Muldoon
Gulch
Gulch
Ridge
Creek
Argosy
25
30
29
28
36
32
33
12
13
18
17
Figure 3
Lake Classification
in the
South-Pioneer Lake System
Key
Blue - Supports fisheries
Orange - Too shallow for fisheries
Yellow - Dry, up or dry
Green - Wet meadows

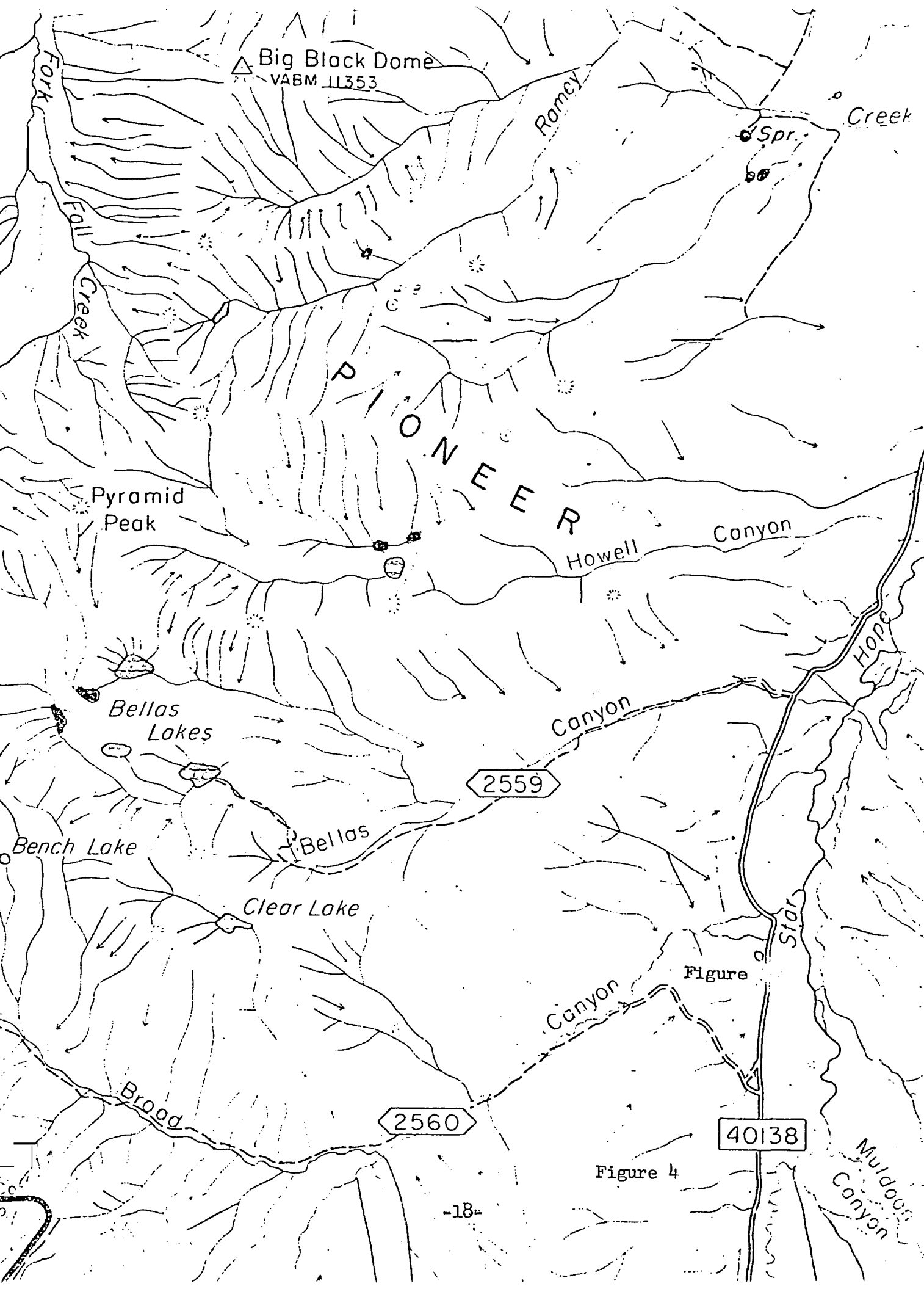

Big Black Dome
VABM 11353
Fork
Fall
Creek
Ramey
Creek
Spr.
PIONEER
Pyramid
Peak
Howell
Canyon
Hope
Bellas
Lakes
Canyon
2559
Bench Lake
Bellas
Clear Lake
Star
Figure
Canyon
Broad
2560
40138
Muldoon
Canyon

Figure 4

A physical inventory was made of the East Fork Big Lost River (table 7) and was found to have very favorable habitat conditions. As a result, this stream provides a good fishery. It averages 36 feet in width and 10.5 inches in depth. Pool rating is low and results in less than adequate depth cover for the trout population. The stream is very clean as far as fine sediment and demonstrates the watershed is very stable.

Streambank condition rates fair to good, but is held down due to extensive livestock damages. Eighty-two percent of all the pools are developed by the streambank which demonstrates the critical conditions heavy livestock use can set up when they damage the streambanks and their vegetation.

Hydrochemistry

Lakes. The Pioneer lakes are less fertile than those studied in the Boulders, but more fertile than the White Cloud lakes. Because they tend to be very shallow lakes, it is to their advantage not to be too fertile so BOD and COD levels are low as water and dissolved oxygen displacement is quite critical as far as fish kills are concerned. As in the other study areas, lakes vary considerably in their fertility. An example is Golden Lake which has a very restricted watershed and very low fertility. For comparison and more detailed data, the reader should study appendix VI in the "White Cloud-Boulder-Pioneer Aquatic Environment and Fisheries Study, Interim Report."

Hardness (as $CaCo_4$) averaged only 35 p.p.m. and alkalinity 31 p.p.m. The pH was high for high mountain lakes in central Idaho and probably

Table 7 Summary of Aquatic Environment Data for the East Fork Big Lost River Collected During August 1968.

Width (Ft.)	Depth (In.)	Riffle (Ft.)	Pool (Ft.)	Pool Rating	Pool Feature (%)	Aquatic Plants (%)	Streambottom Materials (%)				Streambank Conditions*		
							Boulder	Rubble	Gravel	Fines	Cover	Cond.	Type
36	10.5	24	14	3.4	82 Bank 10 Rubble 8 Boulder	2 Rooted 4 Clinging	4	67	23	6	1.3	1.8	1.2

*This stream has extensive bank and cover damage due to livestock operations.

is an indicator of why these lakes are more fertile than the White Cloud or Sawtooth Area lakes. As with most high mountain lakes in the summer, dissolved oxygen was always at near saturation.

Streams. As with the lakes, very little study has been done on stream hydrochemistry. A few tests were conducted on the East Fork Big Lost River to document conditions below a potential mining operation. Hardness was 96 p.p.m. showing an increase over the lake systems. Turbidity was low and copper averaged .026 p.p.m. which is quite high. During the testing (1968-1969) we still did not have our methods on collecting and analyzing heavy metals perfected, and the readings are quite high. The author believes these readings should be below .010 p.p.m., but this should be demonstrated by further study.

Table 8 Summary of Lake Hydrochemistry in the Pioneer Study Area During 1970*

Lake	Hardness	pH	Free Acidity	Total Acidity	Phenol Alk.	Total Alk.	Dissolved Oxygen	Free Carbon Dioxide
Baptie	25	9.0	0	3	8	30	10.5	3
Big	25	8.3	0	0	0	15	10.0	3
Cloudy	34	8.3	0	3	0	30	9.0	3
Golden	17	7.8	0	2	0	10	9.5	3
Goat	34	7.8	0	2	0	17	10.5	3
Green	51	8.7	0	2	8	30	10.0	3
Long	51	9.0	0	0	17	51	10.0	3
Rough	25	7.5	0	2	0	8	10.0	3
Round	51	9.0	0	0	51	91	10.0	3
Average	35	8.4	0	2	9	31	9.9	3

* This data was collected by the author using Hach equipment.

Table 9 Water Suitability Data for the East Fork Big Lost River Drainage (ppm and units)

Date / Station	Test TS	Hd	Turb	Cu
10-15-68				
NF-1	104		<25	.020
EF-1	72		<25	.010
EF-2	72		<25	.030
EF-3	84		<25	.020
EF-4	100		<25	.020
EF-5	96		<25	.020
EF-6	68		<25	.030
Average	85		<25	.021
2-14-69				
NF-1		104	<25	.014
EF-1		140	<25	.020
EF-2		68	<25	.010
EF-3		80	<25	.015
EF-4		104	<25	.017
EF-5		140	<25	.091
EF-6		128	<25	.049
Average		96	<25	.031

BOULDER AREA

Big and Little Wood Rivers, well-known for their fisheries, drain the major portion of the Boulder Study Area. The waters, as they move to offsite areas, develop very important fisheries, as exampled by Magic and Little Wood River reservoirs. The majority of the streams drain fairly fertile watersheds and, in turn, produce good fisheries. The lakes also are more fertile than surrounding areas, such as those found in the Sawtooths and White Clouds.

Lacustrine Environment

Most of the high mountain lakes have been stocked with trout, but few of them successfully. Only Prairie, Norton, Milligan, Lost, Hidden, and Baker lakes have been continually successful (figure 5). Because of the lower elevations, possibly different climatic conditions, less glacial activity, and depositional materials from continual snowslides, the west and south Boulder Areas do not have a good lake type environment. All lakes that do support a fishery get very heavy fishing pressure.

Many lakes, such as Titus (Titus is presently supporting a fishery, but has suffered past winterkills), Mill, Miner, or Smoky, are close to the qualifications of supporting fisheries but lack the complete requirements. Usually what is lacking is water depth because the glaciers did not have the energies or the depth to dig deep pockets or push large amounts of debris to form large dams.

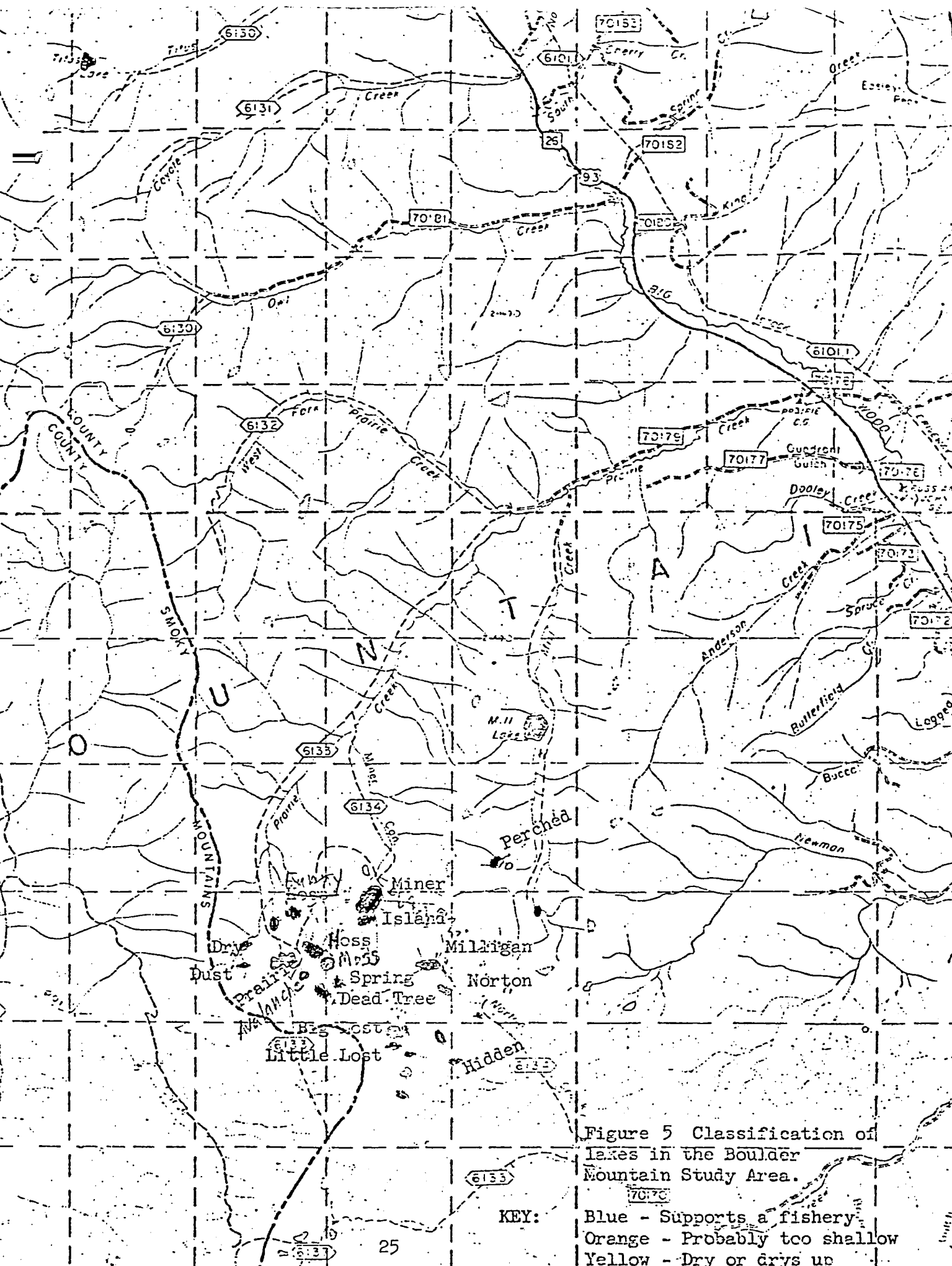
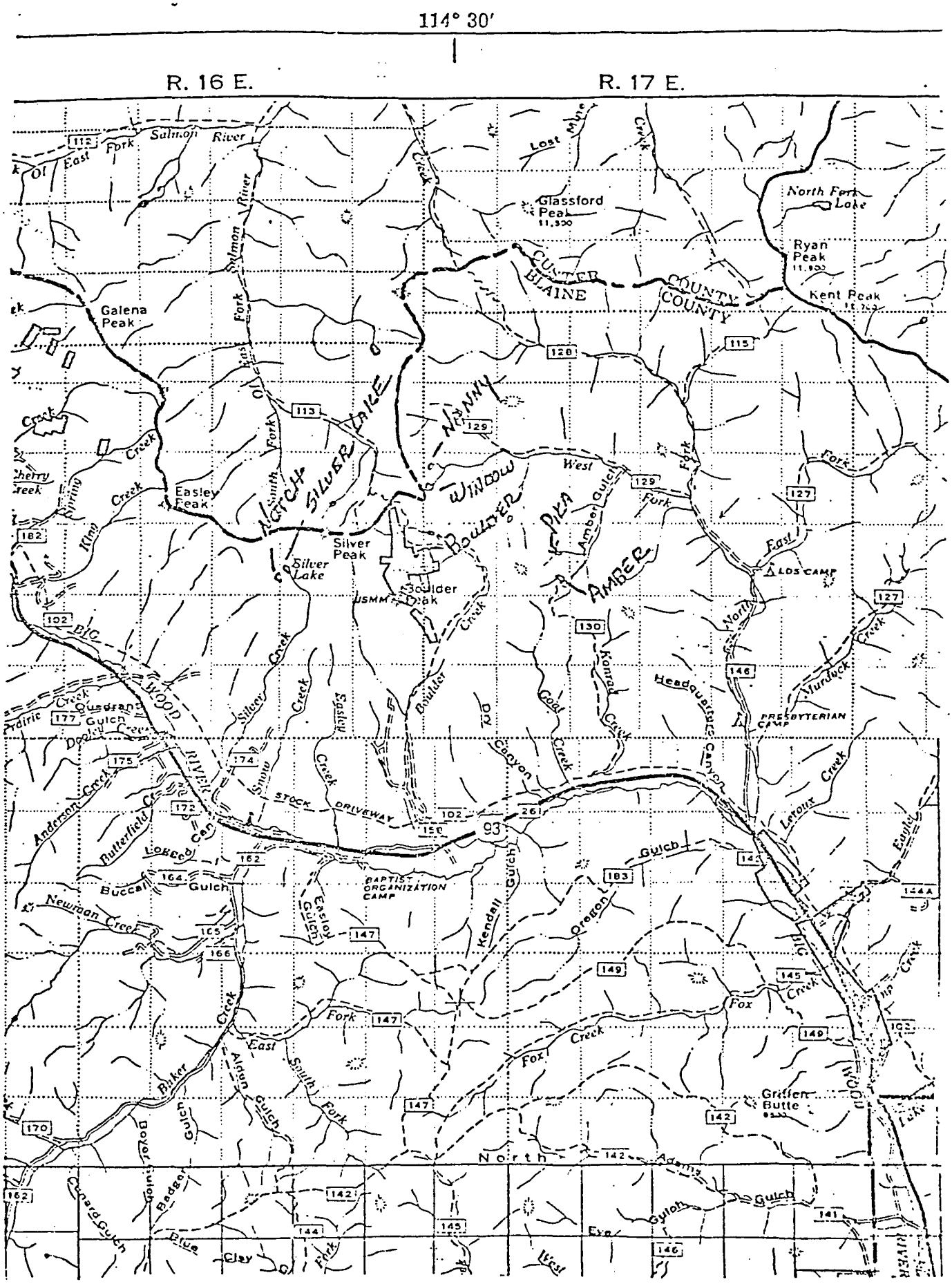

Miner
Island
Hoss
Dry
Dust
Spring
Dead Tree
Big Lost
Little Lost
Hidden
Perched
Milligan
Norton
Newman
Anderson
Butterfield
Dooley
Quadrant
Gulch
Prairie
Creek
Fork
West
Fork
Prairie
Creek
Mill
Lake
Creek
Creek
Creek

Figure 6 East Boulder Lakes



able 10 **Physical condition of the 26 high mountain lakes in the West Boulders Area**

Lakes	Depth Max (ft)	Depth Ave. (ft)	Elevation (ft)	Fluctuation	Natural Reprod.	Fish Species	Shoal Area	Shoal Bottom Rock	Shoal Bottom Fines	Aquatic Rooted Plants	Fish Condition	Fishery Potential
Avalanche	4	2	8,850	Unstable	None	None	100	0	100	none	none	2
Baker	29	23	8,796	Stable	Yes	G,C	20	65	35	none	excellent	1
Big Lost	25	17	9,154	Unstable	Possible	C,Gr	60	90	10	sparse	excellent	1
Dead Tree	3	2	8,865	Stable	None	None	100	5	95	none	none	2
Dollar	15	11	5,040	Stable	Doubtful	B	100	30	70	abundant	good	1
Dry	4	0	8,830	Dry up	None	None	100	20	80	abundant	none	3
Ephemeral	10	0	**	Dry up	None	None	100	20	80	abundant	none	3
Funny	2	1	8,596	Stable	None	None	100	0	100	Abundant	none	2
Hidden	9	4	8,812	Stable	Doubtful	C	100	10	90	Sparse	excellent	1
Hoss	5	4	8,596	Stable	None	None	100	0	100	Abundant	None	2
Island	5	4	8,790	Unstable	None	None	100	75	25	Sparse	none	2
Lake Creek	6	2	6,600	Stable	Yes	B,C	100	5	95	Abundant	good	1
Mill	12	2.5	8,223	Unstable	None	None	100	80	20	Sparse	none	2
Miner	20	11	8,770	Stable	None	N.O.	80	20	80	None	None	2
Moss	5	2	8,701	Stable	None	None	100	0	100	Abundant	None	2
Milligan	17	14	9,170	Stable	Possible	C,R	50	25	75	None	Good	1
Norton	18	14	8,947	Stable	Possible	C,R	50	40	60	None	Good	1
Penny	12	9	5,040	Stable	Yes	R,B,S	100	0	100	Abundant	Fair	1
Prairie	9	5	8,701	Stable	Yes	C,R	100	30	70	Abundant	Excellent	1
Perched	8	3	9,192	Stable	None	None	100	0	100	Abundant	None	2
Shrimp	3	1½	9,025	Unstable	None	None	100	20	80	None	None	2
Slick Rock	4	2	8,870	Stable	None	None	100	0	100	None	None	2
Smoky	14	5	9,023	Stable	None	None	100	20	80	Sparse	None	2
Spring	4	2	8,890	Stable	None	None	100	0	100	None	None	2
Talus	5	3	9,060	Stable	None	None	100	20	80	None	None	2
Titus	19	10	8,871	Unstable	None	R	80	20	80	Abundant	Good	1
Averages	10	6	8,456	Stb. 69% Ustb. 24% D.U. 7%	Yes 15% Psbl.12% DFl. 8% none 65%	B 8% C 27% G 4% Gr 4% N.O.4% none 58% R 23% S 4%	90%	23%	77%	Abundant 43% Sparse 19% None 38%	Excellent 15% Good 19% Fair 4% None 62%	1 = 38% 2 = 54% 3 = 8%

Key

B Brook Trout
C Cutthroat
DV Dolly Varden
G Golden
GR Grayling
N.O. None Observed
R Rainbow
S Suckers

Fishery Potential

1 Supports Fishery; 2 Does not support fisher; 3 Goes Dry.

**Elevation data not available at this time.

Table 11 Average Physical Conditions of 26 High Mountain Lakes in the West Boulders

Water Depth	
Average Maximum	10
Average Depth	6
Water Stability	
Stable	69
Slightly Unstable	24
Very Unstable	0
Complete Loss of Water	7
Natural Reproduction	
Yes	15
Possible	12
Doubtful	8
None	65
Fish Occurrency	
Cutthroat trout	27
Grayling	4
Golden trout	4
Rainbow trout	23
Brook trout	8
None Observed	4
Sucker	4
Lake Shoal Area	
Percent of Lakes in Shoal Area	90
Shoal Area with Rock Bottom	23
Shoal Area with Fines	77

Rooted Aquatics	
None	43
Sparse	19
Abundant	38
Fish Condition	
Excellent	15
Good	19
Fair	4
Poor	0
None	62
Fishery Potential	
Supports Fishery	38
Does not support Fishery	54
Goes Dry	8

* Average Elevation 8,160 ft.

* Includes only elevation from 12 lakes.

Table 12 Physical Condition of the Lakes in the East Boulders.

Lakes	Depth Max (ft)	Depth Ave. (ft)	Elevation (ft)	Fluctuation	Natural Reprod.	Fish Species	Shoal Area	Shoal Bottom Rock	Shoal Bottom Fines	Aquatic Rooted Plants	Fish Condition	Fishery Potential
Amber	17	**	9,275	Stable	none	none	**	100	0	none	none	2
Boulder	10	6	9,550	Stable	none	none	100	20	80	none	none	2
Nanny	6	3	10,000	Drys up	none	none	100	0	100	none	none	2
Notch	8	4	9,882	Drys up	none	none	100	100	0	none	none	3
Pika	9	8	9,175	Drys up	none	none	100	100	0	none	none	3
Silver	8	5	9,842	Unstable	none	none	100	80	20	none	none	2
Window	25	13	9,800	Stable	none	none	50	20	80	sparse	none	2
Average	12ft.	6.5ft.	9,600ft.	Stable 43% Unstb. 14% Drys up 43%	none - 100%	none -100%	92%	60%	40%	none 86% sparse 14%	none 100%	2 57% 3 43%

Key

B Brook Trout
C Cutthroat
D.V. Dolly Varden
G Golden
Gr Grayling
N.O. None Observed
R Rainbow
S Suckers

** No data available at this time.

Fishery Potential

1 Supports Fishery
2 Does Not Support Fishery
3 Goes Dry

Table 13 Average Physical Condition of 7 High Mountain Lakes in the East Boulders

Water Depth	
Average Maximum	12
Average Depth	6.5
Water Stability	
Stable	43%
Slightly Unstable	14%
Very Unstable	0
Complete Loss of Water	43%
Natural Reproduction	
Yes	0
Possible	0
Doubtful	0
None	100%
Fish Occurrency	
Cutthroat Trout	0
Rainbow	0
Brook	0
Lake Shoal Area	
Percent of Lakes in Shoal Area	92%
Shoal Area with Rock Bottom	60%
Shoal Area with Fines	40%
Rooted Aquatics	
None	86%
Sparse	14%
Abundant	0
Fish Condition	
Excellent	0
Good	0
Fair	0
Poor	0
Fishery Potential	
Supports Fishery	0
Does Not Support Fishery	57%
Goes Dry	43%
Average Elevation	9,600 ft.

In some lakes (an example is the Prairie Creek drainage), rights have been acquired for water storage. Ditches have been excavated along with temporary dams to store water in the lakes for midsummer use. Prairie and Miner Lakes have both been used for storage in the past, but have been ignored the past 10 years. These water rights need to be acquired. Stream channel damage, which resulted from rapid discharge of the stored water during release periods, is still apparent.

Because heat budget potential and dissolved oxygen containment are the critical features limiting the fishery potential, correction methods should be studied. There are feasible opportunities to increase these two items in many of the lakes surveyed. It would present some problems in that dams would have to be constructed without access roads and using materials which would blend with the environment and in keeping the natural beauty intact.

Mill Creek Drainage. Mill Lake is one of the larger lakes in the west Boulders (18 acres). Several trout introductions were made in this lake before it was discovered that it has a permeable basin and unstable water levels. During most years, it is dry by early fall. Even during fall dry conditions, it still has about 1 c.f.s. of inflow waters. This lake, because of its potential depth of over 25 feet, is capable, under rehabilitation procedures, of raising large trout. Like many of the lakes in the Boulders, it has snow avalanche problems, but this only affects the upper 20 percent of the lake. This lake deserves additional study. It appears the lake has already sealed 30 percent of the bottom on the inlet side. By grouting or sealing the other 70 percent, this lake could become one of the better lakes in the Boulders.

Perched Lake is too shallow to support fish life, but is quite esthetic. It is an excellent example of how a glacier scooped, deposited, and built a small lake.

Miner Creek Drainage. Like Mill Lake, the two lakes (Island and Miner) in the Miner Lake drainage have greatly fluctuating water levels because of permeability problems. Like most of the lakes in this area, these lakes need some fish survival studies, as it is possible a 6-foot dam could place Miner Lake into an excellent fishery. It does have snow avalanche problems. One snow avalanche area has gouged out a 21-foot hole on the east side of the lake. Although it is responsible for the maximum depth, it and the other one on the west side are probably responsible for annual fish kills. For more detailed information on Boulder Area lakes, see appendix III of the "White Cloud, Boulder, Pioneer Interim Report." Island Lake is too shallow for fish, but does have upwelling during most parts of the year.

Prairie Creek Drainage. The Prairie Creek drainage contains nine lakes, but only Prairie Lake itself will support fish life at the present time. This lake has marginal conditions, as it only has a maximum water depth of 9 feet and an average depth of 5 feet. Springs and one major spring-fed inlet allow this lake to carry a fishery. Some of the other lakes may lend themselves to rehabilitation measures. Many of these lakes, however, are in avalanche paths.

Norton, Lost, and Baker Creek Drainages. The better aquatic environment conditions for this area are found in the Norton and Lost Creek drainages. These lakes (Norton, Milligan, and Lost) do not have deeper depths, but are more protected from winter limiting factors.

Hidden Lake has a maximum depth of only 9 feet, but, because of springs in both shore and bottom, it supports large trout, which again demonstrates the complexities of the aquatic environment in what will and what won't support a fishery.

One of the best methods of analysis would be to compare long-term fish survival studies with physical and chemical conditions. This would allow a better evaluation of those lakes that need increased water depths or bentonite sodium carbonate treatments for basin impermeability treatment. These lakes receive very heavy fishing pressure, and this will continue to increase as the area becomes better known. To better distribute the present and anticipated fishing pressure, efforts could be made at this time to establish fisheries in some of the now barren lakes.

Summary

Lakes in the west Boulders only averaged 10 feet in maximum depth and 6 feet in average depth (tables 10 and 11). Their basins lie at a much lower level than the other areas studied, at an average of 8,456 feet, which demonstrates why snow avalanches play such an important part in lake formation. About 31 percent of the lakes have unstable water levels and of these 7 percent dry up. Only 15 percent of the lakes have definite natural reproduction. Cutthroat and rainbow are the dominant fish species with most of the populations being in good or excellent condition. A nongame fish species (suckers) was found in Penny Lake.

In the east Boulders, seven lakes (tables 12 and 13) were surveyed and none were found that were supporting a fish population. The lakes averaged 12 feet in maximum depth and 6 feet in average depth. The lake basins were located at an average of 9,600 feet which is much higher than the West Boulder lakes. Two lakes (Amber, 17 feet maximum depth and Window, 25 feet maximum depth) have possibilities for fish production. Almost half of the lakes on the west side dry up before winter conditions set in. These lakes need more work to determine what their inputs could be into the recreation resource.

Fluvial Environment

Fertile waters, perennial flows, and low gradient meandering streams offer good aquatic environment over much of the Boulder Study Area. Land uses, however, are degrading this aquatic environment in many areas, as will be discussed later.

Because this area with Sun Valley in the middle of it is a high use recreation area, the available aquatic environment is heavily used. There is very little good lake and reservoir type environment available, and, therefore, streams support most of the fishing use. This area needs more water orientated recreation, and the only way to get it is to form artificial environments and enhance and protect existing environments.

Big Wood River. The waters of Big Wood River are critically needed for irrigation, and some areas of it are completely diverted (dried up) for irrigation. During the low flow period when the fishery is in a critical condition, waters are further lowered due to diversions.

The Federal Bureau of Reclamation has investigated the possibilities of building a large holdover storage reservoir on Big Wood River that could, under proper management, alleviate some of the critical aquatic environment conditions that now exist. The purpose of the reservoir would be for providing supplemental water to lands in the upper Big Wood River Valley. The impoundment (Boulder Flats), located 10 miles above Ketchum, Idaho, in Blaine County, would have an active capacity of 195,000 acre-feet, containing 3,700 surface acres forming a lake 5 miles long and about ½ mile in average width.

The proposed impoundment would eliminate 7 miles of excellent trout fishing streams, which is estimated (1967) to support annually about 750 fishermen days, harvesting approximately 3,500 game fish, with an annual fishery resource value of $2,250. The proposed impoundment would provide a 2.5 square mile of surface water which would support annually an estimated 7,650 fishermen days, harvesting about 26,000 game fish, with an estimated annual fishery resource value of $22,950. The impoundment should, under proper management, promote better fish growth, better survival, more favorable water temperature, enhance streamflows in downstream areas, and possibly eliminate the need for future downstream channel changes by the U. S. Army Corps of Engineers.

Stream channel changes, alinement, and encroachment by roads and homes have eliminated or degraded large areas of the stream. Road construction alone, through stream alinement in upper Big Wood River, has eliminated 1 mile of stream. Many areas have been encroached further degrading the aquatic environment. Big Wood River is far from being the fishery it is capable of because of land use effects.

Table 14

The Length of Stream Channel Altered and the Number of Alterations By Type in Big Lost and Big Wood Rivers*

tream **	Channel Relocation		Channel Clearance		Encroachment		Riprap		Stream Miles	Total Miles Altered	Total Alterations	Percent Altered
	Miles	No.	Miles	No.	Miles	No.	Mi.	No.				
ig Lost	1.76	7	14.47	36	0.15	1	0.14	1	61.07	16.52	45	27
g Wood	2.02	10	10.21	31	0.64	9	0.13	3	58.69	13.00	53	22

Table 15

Length of Stream Channel Altered, Number of Alterations, and Parties Responsible for Alterations in Big Lost and Big Wood Rivers*

tream **	Road Construction		Agriculture		Flood Control		Stream Miles	Total Miles Altered	Total Alterations	Percent Altered
	Miles Altered	No.	Miles Altered	No.	Miles Altered	No.				
ig Lost	0.15	1			16.37	44	61.07	16.52	45	27
g Wood	0.64	9			12.36	44	58.69	13.00	53	22

[redacted]arry, Idaho Fish and Game
[redacted]ions of streams lie outside study area

Table 16

Number of Fish Less than 6 Inches, Greater than 6 Inches, and Weight of Fish Censused in Equal Areas of Altered and Unaltered Stream Channel in Big Lost and Big Wood Rivers*

tream**	Channel Type	Less Than 6 Inches		Greater Than 6 Inches		Total Game Fish	Weight		
		Trout	Whitefish	Trout	Whitefish		Trout	Whitefish	Total
ig Lost	Altered	3	9	19	0	31	7.0	5.7	12.7
	Natural	44	0	55	1	100	14.3	.2	14.5
ig Wood	Altered	1	0	1	0	2	0.8	0	.8
	Natural	10	0	11	0	21	0.7	0	.7

izarry, Idaho Fish and Game
rtions of streams lie outside study area

Because of its proximity to Sun Valley and the fact that it flows along U. S. Highway 93, the Big Wood is heavily used as a fishery. Although it still produces a fair number of trout, the Big Wood has been greatly degraded in recent years. Environmental degradation, plus heavy fishing pressure has resulted in almost entirely a put-and-take fishery. Fish and game stocking records show that between October 7, 1969, and September 9, 1970, a total of 79,270 fish, weighing 22,680 pounds, were planted in the Big Wood. It is doubtful that improvement of spawning grounds could bring natural reproduction up to the point where supplementary stocking would not be needed, but reclaiming of degraded areas and improvements on tributary streams could increase native trout populations significantly.

Most of the degradation of the Big Wood was directly due to poor land use practices such as highway construction and overuse of stock driveways. Prior to 1965 as many as 175,000 sheep were driven over the Ketchum-Stanley stock driveway every spring and fall. This concentrated use resulted in extensive erosion problems which added greatly to the sediment load in the river. In 1965, use of the driveway was limited to the fall, and the number of sheep was reduced to between 15 and 20 thousand. The eroded areas were contoured and seeded with grass and now appear to be quite stable.

When the new highway was built between Ketchum and Stanley in the late 1950's, several sections of stream were channeled and relocated. This channelization resulted in the destruction of approximately 1 mile of

habitat. By cutting out many meanders, the gradient was made steeper thereby increasing downstream water velocity. The accelerated spring runoffs have created severe bank erosion problems in several areas; therefore, much more than the originally altered mile has been adversely affected. One of the most notably unstable stretches is the section near the mouth of Silver Creek. Several gabions have been installed, but there is still a lot of bank erosion on the bend above the Silver Creek bridge. Unless this bend is stabilized, the river will soon alter its course sufficiently to wash out the bridge.

In 1968, 1969, and 1970, the Boy Scouts under the direction of Clair Baldwin undertook a stream improvement project in Horse Creek just above the confluence with the Big Wood River. This was a straight section of relocated stream with high current velocity, unstable banks, and no suitable trout habitat. The Scouts installed K-dams approximately every 100 feet, which produced a stairstep effect. This reduced velocity, produced good pools, and permitted the banks to vegetate and stabilize, thereby greatly improving habitat quality. Trout are now present in all of these pools. This small volunteer project serves as an excellent example of an inexpensive and fairly efficient method for reclaiming degraded sections of stream that lend themselves to this type treatment.

That portion of the Big Wood above the confluence with Horse Creek is too small to consider as a fishery. From Horse Creek to about ½ mile below Galena Store there are four channeled stretches which need to be considered for habitat improvement. The banks are quite stable except for the last

Table 17 A Summary of Physical Aquatic Habitat Information from Big Wood River and Some of its Main Tributaries Within the Study Area.

Stream	(Feet) Width	Depth	Riffle	Pool Width	Pool Rating	Streambed Surface Composition (Percent) Boulder	Rubble	Gravel	Fines	Bank (Units) Cover	Condition	Type	Gradient (Percent)	Pool Feature (Percent) Boulder	Log	Bank Rubble	Bank Gravel		
Adams Gulch	9	4	8	1	4.8	5	42	48	5	1.2	1.1	-	2.1	54	5	24	15	-	2
Baker Creek	18	11	17	1	2.4	6	40	51	4	1.3	1.1	-	1.4	13	72	-	-	15	-
Big Wood River	38	12	37	1	2.6	1	57	26	6	1.2	1.0	-	1.1	31	34	30	5	-	-
Corral Creek	14	9	12	2	3.4	23	25	45	7	1.5	1.1	-	2.1	30	62	8	-	-	-
Norton Creek	9	5	8	1	4.6	27	41	32	0	1.2	0.8	-	6.7	63	37	-	-	-	-
Owl Creek	11	7	9	2	2.8	9	41	50	0	1.4	1.0	1.6	2.1	67	27	-	6	-	-
Prairie Creek	15	9	14	1	3.5	15	31	43	8	1.6	1.2	-	1.6	47	50	-	-	3	-
Warm Springs Creek	30	13	28	2	3.3	13	56	27	4	1.2	1.5	-	1.2	55	4	34	7	-	-
Averages	18	9	17	1	3.4	12	42	40	4	1.3	1.1	1.6	2.3	45	36	12	4	2	1

channeled section, but there are very few pools or resting areas for fish. From Galena to the Prairie Creek bridge, the Big Wood is generally very good habitat and receives quite heavy fishing pressure. This section contains natural meanders, deep-sheltered pools, and well-vegetated, stable banks.

Between Prairie Creek and Easley Campground the river is relatively straight and swift with few large pools. The substrate is well scoured, large rubble and boulder, with many shifting gravel bars. Two sections were channeled in this area--a large section above Silver Creek and a shorter one above the highway bridge at Easley. From Easley to the mouth of Boulder Creek the fishery habitat is very good with many large, deep pools and generally stable, vegetated banks. Many trout were observed through this section.

The Boulder flat section has a lower gradient and consequently is an area of deposition of sand and gravel. The river channel has changed many times here, and the banks are mostly bare, sloping gravel bars. There are several small stretches in this area that afford good trout habitat, but as a whole this section can only be considered fair as a fishery. From Wood River Campground to North Fork the river is quite straight and swift with a predominately boulder-rubble substrate. The banks are stable and well vegetated, but there are few pools or resting places for trout. From North Fork to Lake Creek much of the land along the Big Wood is privately owned, most of which has been subdivided for summer home sites. The habitat along this stretch has been greatly

degraded by channel alterations and riprapping to protect the homes from high water. A great deal more construction is anticipated in this area in the near future, and unless a buffer zone is established along the bank and heavy equipment kept out of the stream, the habitat along this entire section could be completely destroyed.

Trail Creek. Trail Creek had a well-established and well-known fishery prior to 1954 when climatic storms on heavy snowpacks caused flood conditions. The flood consisted of extremely high water with heavy loads of sediment, which resulted in serious damage to stream channels and banks. Stream channels changed locations in many places and have since been unstable. Evidently it was a climatic storm on mainly undisturbed watersheds, so it was undoubtedly a natural occurrence. Most of our streams and their aquatic environment were formed in this manner and often nature will be the main healer, possibly it could be helped by artificial means.

Because Trail Creek is in close proximity to Sun Valley (passes directly) and other population centers, it has the potential of receiving heavy fishing pressure. Studies now in the process will help outline measures to return Trail Creek to a more optimum fishery in a shorter period of time.

During the 1954 storm, bedload carried by Trail Creek did considerable damage to an artificial lake within the Sun Valley properties. The corporation had just spent $3,000 cleaning the lake of accrued sediment and this was a total loss.

The village of Ketchum takes its water for culinary, municipal, and irrigation purposes, so the water supporting the fishery is further utilized.

Warm Springs Creek. Warm Springs Creek, which flows into the Big Wood River at the City of Ketchum, is one of the most popular recreation areas in the Wood River drainage. Although developed recreation sites are almost nonexistent, the stream is utilized heavily by campers and fishermen. Warm Springs Creek is a fairly straight, high-energy stream with considerable fluctuations in discharge. In most years it varies from over 400 c.f.s. during spring runoff to less than 100 c.f.s. in the fall. Although much of the stream is too swift or unstable to afford good trout habitat, it is still regarded locally as a fairly productive trout stream. It is stocked several times each summer by the Idaho Fish and Game Department. Stocking records show that 16,935 fish weighing 5,825 pounds were planted from May 26, 1970, to September 1, 1970.

Considerable mining and logging activities have been carried out for many years throughout the drainage area; and although these operations could possibly be contributing to increased runoff and sediment load, no evidence was found to substantiate this.

Sheep grazing has had some impact upon several sections along the upper portion of the stream. The canyon bottom is used as a driveway in late summer, and extensive bank damage was observed in several areas between Rooks Creek and Placer Creek. This not only destroys a vital portion of

Table 18

Summary of Aquatic Habitat Data for the Streams Within Boulders Study Area

Area	Pool Feature (Percent)				Stream			Pool		Streambed Surface Compos. (Percent)				Banks		
	Bou.	Log	Bank	Rub.	Width (ft.)	Depth (in.)	Riffle (ft.)	Width (ft.)	Rating	Boul.	Rub.	Gravel	Sed.	Cover	Cond.	Type
Lake Creek	21	5	63	11	8	5	7	1	4.5	6	41	53	0	0.9	1.5	1.1
Trail Creek	38	0	50	2	28	12	21	7	3.8	18	53	24	4	1.0	0.8	1.4
Eagle Creek	38	0	25	12	9	7	7	2	3.0	0	36	59	5	1.0	1.5	1.4

the trout habitat, but also greatly increases the sediment load of the stream. An adequate number of permanent springs exist along the higher areas so that watering troughs could be built and thereby eliminate the necessity of driving sheep into the creek bottom. The protection of this valuable recreation stream well warrants the expense of spring development and rerouting of the sheep driveway.

About 377 acres along Warm Springs Creek within the National Forest are privately owned--160 acres in the lower Board ranch, 146 acres in the upper Board ranch, 54 acres at Crony Cove, and 17 acres at the mouth of West Fork Warm Springs Creek. Most of this land has been subdivided into summer home sites. Much of the stream through the lower and upper Board ranches has been channeled and straightened to prevent spring flooding of pastureland and summer homes. These alterations have created fast-water chutes and thereby eliminated much trout habitat. Not only is there destruction of habitat in the altered sections, but also the increased water velocity has created unstable bank and substrate conditions downstream. It may be possible to install structures such as gabions and K-dams to reduce the damage incurred during periods of high water and would also create new pools and improve trout habitat.

Prairie Creek. Prairie Creek originates from the outlet of a series of shallow mountain lakes on the north slopes of the Big Wood River drainage. Approximately 6½ miles of stream exists between Prairie Lake and the confluence with the Big Wood River.

Although a few small trout (4-6 inches) were observed in a few pools in the upper meadows, the upper 4 miles of steam are too small and shallow to support a worthwhile fish population. There is considerable evidence of scouring by high spring runoff and winter ice. This ice formation combined with shading by deep snow would probably lead to extensive winterkills. The lower portion, below the confluence with West Fork of Prairie Creek, appears large enough to support a fishery. The section of stream between Mill Creek and the end of the road contains excellent habitat. Below Mill Creek the stream is quite straight and swift; the banks are generally quite stable, but there are very few pools or resting spots for trout.

Corral Creek. Corral Creek is a small stream which originates in the western slopes of the Pioneer Range. It flows into Trail Creek about 4 miles northeast of Sun Valley. Because of this nearness to a resort area and the presence of a road which parallels the stream for 4 miles, the lower area is heavily used by recreationists.

Approximately the first 5 miles of stream was included in the inventory. Above this point the creek is too small and steep to warrant investigation for potential fisheries.

Between stations 4 and 5, the stream flows at the base of a high and very steep north-facing slope. Deposition of debris by avalanches along this section gradually built up the streambottom and on June 27, 1970, high water caused a shifting of the channel for about ¼ mile. This shift

washed out a portion of the road which has since been relocated higher up the hill. It appears that this washout was caused by natural catastrophic events and was in no way due to the presence of the road. The banks are composed of very loose, unstable stream gravel and are still sloughing through this section.

The lower 3 miles of the stream appears to be very good trout habitat. The banks are lined with willow and alder and are well sodded. Considerable evidence of beaver activity was noted, and a good population of 6-8 inch brook trout was observed in the ponds. No rainbow trout were observed during the physical inventory, but several local anglers have reported taking 12-14 inch rainbow from this section in the early 1960's. There is no mention of Corral Creek in the stocking records of the Idaho Fish and Game Department.

Not only are small trout streams such as Corral Creek esthetically pleasing and desirable to many anglers, but they also help to relieve some of the pressures on the more heavily fished areas.

Norton Creek. Norton Creek is a small stream fed by five mountain lakes on the south slopes of Norton Peak. It is an extremely high-energy stream dropping approximately 2,000 feet elevation in 3 miles where it flows into Baker Creek. The discharge in Norton Creek undergoes wide annual fluctuations (high watermarks near the mouth showed a 2-3 foot drop by August 31). Considerable amounts of materials are carried

down this stream with the spring runoff, but this appears to be natural and not man-caused. Little or nothing could be done to produce a fishery here due to the geology and topography of the drainage area, plus the high energy within the system.

Lake Creek. The Lake Creek drainage, because of very low maximum peak flows and adequate minimum flows through the middle portion of the watershed, has the potential for supporting a much heavier recreation use than it is now providing. Aquatic environment improvement resulting in increased recreation use can be attained by enlargement of two existing lakes, creation of a natural lake in an existing basin, and stream improvement in Lake Creek below lower Lake Creek itself.

The Lake Creek drainage lies within a heavily used recreation area that is in need of additional recreation resource to meet the constantly expanding use. Due to lack of surface water, water-oriented recreation areas are lacking. If this heavily utilized area is to have a more properly balanced recreational resource, the water environment is going to need development.

The aquatic habitat survey on Lake Creek was the first study conducted by the author where a stream was relatively free of fines. See table 18. Avalanche slides and slumps blocking off surface waterflows, plus conditions favoring subsurface waterflows, have caused almost complete stability.

Lake Creek waters (table 21) are much better suited for fish production than the majority of our waters. In other words, all we have to do is combine the available water with some aquatic habitat to produce excellent fisheries.

The drainage has had an abundance of exploratory mining and some mine shafts have been excavated. The New Jersey Lead Company, 504 Columbia Building, Spokane, Washington, has been operating in the Lake Creek drainage. They installed a mill, but it was destroyed by landslides. This stream is being monitored at the present time.

Baker Creek. Baker Creek originates on the eastern slopes of the Smoky Mountains and flows into the Big Wood River about 16 miles north of Ketchum.

The physical inventory included approximately 10 miles of stream, of which the lower 8 miles could be considered good fishery habitat. The entire length of Baker Creek is accessible by gravel road. There is only one small section near the mouth of Boyer Gulch were the road is near enough to the creek to have some effect upon bank condition.

This drainage has no developed recreation sites, but because of its easy accessibility, is quite heavily utilized by campers and fishermen.

Logging operations have been carried out in several tributary drainages of Baker Creek--Newman Creek, East Fork of Baker Creek, Norton, Apollo, and Brodie Creeks, and in the upper portion of main Baker Creek.

Although there were several large clear cuts on steep terrain, the roads and skid trails are very stable and do not appear to be adding to the sediment load of the stream. Some bank damage has occurred from sheep grazing in the meadow section near the mouths of Alden Gulch and South Fork of Baker Creek.

In general, Baker Creek appears to be in good condition and would support a substantial population of trout. The only real unstable portion is that ¼ mile stretch immediately below the mouth of Norton Creek. This is primarily due to the heavy spring runoff from the Norton drainage.

There are no records of planting Baker Creek in the Idaho Fish and Game Department stocking reports, but a few trout were observed in most sections.

Hydrochemistry

The Boulder Study Area contained the most fertile waters of the three areas in this study. The lake systems have higher hardness, are higher in total solids, and are more basic as compared to the White Cloud and Pioneer Study Area. The water lends itself very well to the production of a favorable organic product. It only has to be tied to favorable aquatic habitat to produce an excellent fishery. Because of its excellent fertility, those waters entering the proper environment are capable of producing a much needed resource.

Lacustrine. The lakes surveyed during the summer field season were quite saturated with dissolved oxygen. However, due to the limited dissolved oxygen contained at time of freezeup plus the winter buildup of free carbon dioxide and other gasses, these items are probably the most critical items for fish survival. Snow and ice replacement of the liquid water, however, is another critical item.

The lowest elevation lakes - Dollar, Penny, and Lake Creek - are the most fertile lakes and do produce good fisheries. One lake (Perched) lies in a limited small watershed composed of granitics which show up in the low fertility. Some of these lakes have phenol-alkalinity, which is quite uncommon in high mountain lakes within the study area.

Table 19 Average Hydrochemistry Data for 21 Lakes in the Boulder Study Area (1970)

Test	Average p.p.m. or units
Hardness	67.0
Phenol-alkalinity	6.1
Total alkalinity	65.0
pH	8.6
Free acidity	0.0
Total acidity	5.0
Dissolved oxygen	9.0
Free carbon dioxide	5.4

Present land uses have little effect on the hydrochemistry of these lakes. Some land uses could affect the lakes by increasing incoming sediment loads, thus decreasing already critical water volume and depths.

Penny Lake was the only lake surveyed that had a nongame fish problem. This lake may need to have species control in future years.

Table 20

Summary of Lake Hydrochemistry
in the Boulder Study Area During 1970*

Lake	Hardness	Phenol Alk	Total Alk	pH	Free Acidity	Total Acidity	Dissolved Oxygen	Free Carbon Dioxide
Baker	34	0	34	8.0	0	5	9.5	-
Big Lost	51	12	47	8.6	0	3	9.0	-
Dead Tree	68	0	56	8.5	0	14	9.0	-
Dollar Lake	85	0	119	8.5	0	10	9.0	-
Funny	51	0	25	8.0	0	0	8.5	5
Hidden	68	0	68	8.0	0	0	9.0	5
Hoss	51	0	55	8.0	0	5	9.0	-
Island	68	20	70	9.0	0	0	10.0	0
Lake Creek	195	0	170	8.5	0	10	-	10
Mill	51	0	51	8.3	0	0	8.5	5
Miner	51	25	68	8.8	0	5	-	5
Moss	51	0	55	8.0	0	7	9.0	5
Mulligan	51	10	59	9.0	0	0	9.0	-
Norton	68	15	60	9.0	0	7	9.0	-
═ny	135	0	119	8.7	0	17	-	3
═ched	8	0	21	8.3	0	0	8.5	10
Prairie	68	30	65	9.5	0	0	9.5	-
Slick Rock	68	0	56	8.5	0	7	9.0	-
Smoky	68	15	51	9.0	0	6	9.5	-
Spring	60	0	56	8.0	0	5	8.5	6
Titus	51	0	51	8.8	-	-	-	-
Average	67	61	65	8.6	0	5.0	9.0	5.4

*Data collected with Hach field equipment

Fluvial. The streams like the lakes are also fertile and capable of producing good fisheries. Due to aquatic habitat degradation from land uses, segments of the environment are not capable of producing a good fishery resource.

With total solids running over 175 p.p.m., total dissolved solids over 135 p.p.m., and both hardness and alkalinity over 100 p.p.m., the biomass has the necessary inorganic materials to utilize in the developing of the food chain.

Hydrochemistry measurements will continue in streams being affected by land uses, so any detrimental influences or changes will be picked up.

WHITE CLOUD AREA

Almost all the White Cloud Area lies within the proposed Sawtooth National Recreation Area boundary so the majority of the information for this area appears in the main report. The information in this report is miscellaneous data and most of it does not appear in the main report.

The aquatic environments within the White Cloud Area are quite infertile and the data demonstrates they are what an ecologist would expect to find within a predominantly granitic type environment. The waters are very infertile and result in the smaller streams containing a low standing crop of fish. Dolly Varden, cutthroat, and rainbow, along with whitefish predominate the resident game fish populations.

Table 21

Water Suitability Data for the Lake Creek Drainage (Ketchum Ranger District) in ppm and Units (1968)

Station	Test				
	TDS	TS	Cu	Ag	Pb
1	180	204	<.005	<.01	<.01
2	170	200	<.005	<.01	.03
3	160	188	<.005	<.01	<.01
4	155	184	<.005	<.01	<.01
5	170	204	<.005	<.01	.05
6	170	208	<.005	<.01	<.01
Average	164	197	<.005	<.01	.02

Table 22

Summary of Stream Hydrochemistry for Warm Springs Creek (Big Wood River Drainage) June 1969

Station	Test						
	Zn	TS	Fe	Alk	Turb	Ag	Pb
1	.06	116	.24	84	<25	.03	<.01
2	.14	336	.31	168	<25	.02	<.01
3	.03	108	.14	80	<25	.01	<.01
Average	.07	187	.23	117	<25	.02	<.01
Upper tailing pond*	.44	332	2.03	<10	-	.04	12.10
Lower tailing pond*	50.07	1004	42.06	<10	-	.14	11.44

*Basset Gulch Cardnial Silver Mines, Inc.

Table 23

Water Analysis of Samples Collected April 6, 1969,
in Lake Creek (Big Wood River Drainage) Expressed in ppm

Test	Station						Average
	1	2	3	4	5	6	
Total dissolved solids	152	152	156	160	168	170	160
Turbidity	<25	<25	<25	<25	<25	<25	<25
Total solids	172	172	176	182	192	186	180
Alkalinity	144	144	136	128	132	152	139
Hardness	150	144	136	148	156	158	149
Iron	.02	.09	.11	.06	<.01	<.01	.05
Copper	.01	.01	.03	.01	<.01	.02	.02
Zinc	.01	.01	.03	.02	.01	.02	.02

Table 24

Water Analysis of Samples Collected October 31, 1968,
in Lake Creek (Big Wood River Drainage)
Expressed in ppm and Units

Test	Station						Average
	1	2	3	4	5	6	
Total solids (dissolved)	140	142	156	137	145	170	148
Turbidity	<25	<25	<25	<25	<25	<25	<25
Total solids	162	164	178	192	200	194	182
Alkalinity	128	148	136	136	120	136	134
Hardness	130	130	144	132	136	152	137
Iron	.07	.07	.01	.07	.09	.08	.07
Copper	.02	<.01	<.01	<.01	<.01	.01	<.01
Zinc	.01	<.01	<.01	<.01	<.01	.01	<.01

Table 25

Water Suitability Analysis of One Sample Period
from Eagle Creek (Ketchum Ranger District) in ppm and units (10-31-68)

	Test							
Station	Turb	TDS	TS	Alk	Hd	Fe	Cu	Zn
3	25	135	188	104	108	.07	<.01	.04

Table 26

Summary of Selected Stream Hydrochemistry
Located Within the Boulder Study Area 1969-1970

	Test								
Stream	Turb	TDS	TS	Alk	Hd	Fe	Cu	Zn	Ag	Pb
Eagle Creek	< 25	135	188	104	108	.07	<.01	.04		
Lake Creek	< 25	169	173	137	143	.06	.017	.02	.01	.02
Warm Springs	<25		187	117	-	.23	-	.07	.02	.01
Big Wood River	<25	148	182	134	137	.07	<.01	<.01		

Table 27

Water Suitability Data for the
East Fork Big Lost River Drainage (ppm and units)

Date / Station	Test TS	Hd	Turb	Cu
10-15-68				
NF-1	104		<25	.020
EF-1	72		<25	.010
EF-2	72		<25	.030
EF-3	84		<25	.020
EF-4	100		<25	.020
EF-5	96		<25	.020
EF-6	68		<25	.030
Average	85		<25	.021
2-14-69				
NF-1		104	<25	.014
EF-1		140	<25	.020
EF-2		68	<25	.010
EF-3		80	<25	.015
EF-4		104	<25	.017
EF-5		140	<25	.091
EF-6		128	<25	.049
Average		96	<25	.031

Table 28

Summary of Aquatic Environment Data for the
East Fork Big Lost River Collected During August 1968

Width (ft.)	Depth (in.)	Riffle (ft.)	Pool (ft.)	Pool Rating	Pool Feature (%)	Aquatic Plants (%)	Stream Bottom Materials (%)				Streambank Conditions*		
							Boulder	Rubble	Gravel	Fines	Cover	Cond.	Type
36	10.5	24	14	3.4	82 Bank	2 Rooted	4	67	23	6	1.3	1.8	1.2
					10 Rubble	4 Clinging							
					8 Boulder								

*As in many other areas, this stream has extensive bank and cover damage due to cattle grazing

Stream Diversions

The major writeup on stream diversions appears in the major report. Additional data appears here for a matter of record.

Location and Description of Stream Diversions. Pole Creek is the first stream in the headwaters of the Salmon River that is affected by stream diversion. There are four diversions located below the National Forest on public lands.

1. Small box outlet - the main channel is never diverted; has a 10-15 c.f.s. diversion capacity.
2. Small wooden diversion box with facilities to dam and divert complete channel. Ten to 15 c.f.s. diversion capacity.
3. Has facilities to construct dam and divert complete channel flow. Fine to 10 c.f.s. diversion capacity.
4. Has facilities to construct dam and divert complete channel flow.

Pole Creek has a calculated spring runoff of 80-100 c.f.s. By July the discharge has declined to 15-25 c.f.s. The investigation indicates that Pole Creek is fully diverted for 2 to 3 months during the summer season. This produces ½ to 1½ miles of dry stream channel. The last ½ mile of channel below the last diversion has a deteriorated channel bank. The lack of summer flows has reduced the bank vegetation, and high spring flows are actively cutting at the banks, and during normal runoff can completely dry the Salmon River channel for ½ to 3/4 mile before ground water provides some water to help bring back some fishery habitat. On certain years this diversion is very detrimental to salmon runs.

Though not a complete diversion, this is the only diversion that is screened for downstream moving fish. It bypasses 25-35 c.f.s. and is diverted by placing large boulders in main channel. This diversion could create fish passage delays, but does not completely stop fish migration.

Beaver Creek is a small side drainage that drains the canyon area where the old Sawtooth City is located. It is a major tourist attraction. The fishery and recreation values of this stream will receive high priority.

1. This diversion is located just below Highway 93. It does not have facilities to completely divert all water at the present time, but during low waterflow it does reduce the channel flow sufficient to restrict fish movement - 10 c.f.s. capacity.

Alturas Lake Creek is a major tributary of the Salmon River headwaters. Streamflows range from 350 c.f.s. during spring runoff to less than 25 c.f.s. during the summer season. It drains Alturas Lake and provides a major route for anadromous fishery from the Salmon River up to Alturas Lake.

Alturas Lake Creek diversion has a capacity of 20 c.f.s. The cement diversion structure is capable of complete diversion, except for seep flows that can maintain some of the deeper pools for approximately 1½ miles of channel during low water. The dry channel conditions start after spring flow between July 1 and 20 until September 15, when irrigation season is complete.

Vat Creek is within the Alturas Lake Creek drainage and is not a diversion as such, but is a wet meadow drainage project. Several drainage ditches,

6-8 feet deep have been constructed with gates to control the water table. There is a need for further investigation in this area.

Champion Creek was not fully investigated, but one diversion was described.

1. This diversion has facilities to completely divert all channel water. The channel is dry for ¼ mile below the diversion during August and September. This diversion has probably had some impact on what was once a large Dolly Varden run.

Fourth of July Creek drains a large recreation area that receives heavy use.

1. This area consists of two small diversions that take water to the glacial outwash bench above Sawtooth Valley Ranger Station. Both diversions have restrictions placed on them during low flows to divert water, but neither completely diverts all the water.

2. This diversion has facilities to completely divert all the channel flow. The dam below Highway 93 is frequently closed and the channel for several hundred feet becomes completely dry. As with Champion Creek, these diversions could have stopped what was once a good Dolly Varden run.

This diversion is capable of complete channel closure. Again, like the other channels discussed, this stream channel can be dewatered for ½ mile and thus reduce any fish migration for 2 months during summer flows.

The main channel of the Salmon River has some large diversions with some being completely shut off.

This diversion is located near the confluence of Pole Creek and diverts 5-10 c.f.s. of water to supplement the area irrigated by Pole Creek. During low water years when Pole Creek does not provide sufficient flow to reach the lower diversion, this diversion may be rocked or other restrictions used in the main channel for more water diversion.

1. This diversion is located on a split channel of the main river. It diverts 15-20 c.f.s., but never closes the main channel.

2. This diversion has a cement structure capable of complete diversion of the main Salmon River. During low water years, this diversion is known to have been closed as early as June 25. The diversion ditch has a capacity of 50 c.f.s.

Hydrochemistry

Due to potential mining operations, considerable hydrochemistry data has been collected in the White Cloud Study Area. It is compiled here for a matter of documenting aquatic environment conditions so future changes can be determined. The information shows the environments are very infertile and demonstrates the pristine conditions that exist over much of the area. The majority of the area is in natural conditions as the tests indicate. The analysis of most of this data is found in the main report so it will not be repeated again here.

Some miscellaneous lake hydrochemistry appears in the last table.

Hydrochemistry Individual Sampling Information for The Little Boulde
Drainage, White Cloud Area, Idaho.

Year	Month	Day	Station	TDS	TS	Fe	Cu	Pb	Zn	Hg	TESTS Alk	Turb	Hd	Mo	Co	pH	O2	Al	Si	Cl	Na	Number of Samples Collected Per Month and Year
1969	5	28	2													7	10					
			3													7	10					
			4													7.3	9					
			5													7	9					
			6													8	9					
Monthly Ave.																7	9					5
1969	7	9	1c	123	144						72		96					<.1	9	34	1	
			1f	92	112						48		76					<.1	4	28	3	
			3	84	104						40		52					<.1	4	32	2	
	7	10	4	87	104						36		40					<.1	4	40	3	
			5	87	108						52		52					<.1	5	30	4	
			6	142	160						92		116					<.1	3	30	7	
	7	24	1c	80	92	.03	<.01					<25		<.01								
			1f	126	146						76		92					.2	8	28	8	
			2	78	90	<.01	<.01					<25		<.01								
			3	79	92	<.01	<.01					<25		<.01								
			4	84	94	<.01	<.01					<25		<.01								
			5	86	100						40		60					<.1	4	23	4	
			6	120	144						64		72					<.1	4	25	6	
Monthly Ave.				97	115	*<.01	*<.01				58	<25	73	*<.01				*<.1	5	30	4	13
1969	8	8	1	113	134	<.01	<.01					<25		<.01								
			1c	65	114	<.01	<.01					<25		<.01								
			1f	127	168	<.01	<.01					<25		<.01								
			2	87	160	<.01	<.01					<25		<.01								
			3	87	144	.05	<.01					<25		<.01								
			4	92	160	<.01	<.01					<25		<.01								
			5	95	168	<.01	<.01					<25		<.01								
			6	133	156	<.01	<.01					<25		<.01								
	8	21	1	110	120	<.01	<.01					<25		<.01								
			1c	65	120	<.01	<.01					<25		<.01								
			1f	123	196	<.01	<.01					<25		<.01								
			2	95	102	<.01	<.01					<25		<.01								
			3	90	118	<.01	<.01					<25		<.01								
			4	92	168	.06	<.01					<25		<.01								
			5	98	72	<.01	<.01					<25		<.01								
Monthly Ave.				98	147	*<.01	*<.01					*<25		*<.01								15
1969	9	5	1	117	124	<.01	<.01					<25		<.01								
			1c	65	90	<.01	<.01					<25		<.01								
			1f	133	152	.02	<.01					<25		<.01								
			2	98	164	<.01	<.01					<25		<.01								
			3	98	112	<.01	<.01					<25		<.01								
			4	102	140	<.01	<.01					<25		<.01								
			5	102	104	<.01	<.01					<25		<.01								
			6	145	162	<.01	<.01					<25		<.01								
	9	25	1	108	160	<.01	<.01					<25		<.01								
			1c	72	114	.01	<.01					<25		<.01								
			1f	123	132	.12	<.01					<25		<.01								
			2	95	126	.10	<.01					<25		<.01								
			3	95	118	.15	<.01					<25		<.01								
			4	98		.06	<.01					<25		<.01								
			5	98		.10	<.01					<25		<.01								
Monthly Ave.				103	137	* .04	*<.01					*<25		*<.01								15
1969	10	30	1	107	118		<.01	.02				<25										
Monthly Ave.				107	118		*<.01	.02				*<25										1
Yearly Ave.				99	133	* .20	*<.01	.02			58	*<25	73	*<.01								49

Table 29 (continued) Hydrochemistry Individual Sampling Information for the Little Boulder Creek Drainage, White Cloud Area, Idaho.

Year	Month	Day	Station	TESTS TDS	TS	Fe	Cu	Pb	Zn	Hg	Alk	Turb	Hd	Mo	Co	pH	O_2	Al	Si	Cl	Na	Number of Samples Collected Per Month & Year
1970	1	6	5	110	120	<.01	<.01		<.01				48	<.01								
			6	145	156	.03	<.01		<.01				108	<.01								
		17	5	94	104	.02	<.01		<.01				40	<.01								
		19	5	114	124	<.01	<.01		<.01				72	<.01								
			6	145	156	<.01	<.01		<.01				84	<.01								
Monthly Ave.				122	132	*<.04	*<.01		*<.01				72	*<.01								5
1970	2	9	5	117	124	.02	<.01		<.01				56	<.01								
			6	145	152	<.01	<.01		<.01				100	<.01								
	2	25	5	122	125	.03	<.01		<.01				52	<.01								
			6	145	152	<.01	<.01		<.01				112	<.01								
Monthly Ave.				132	138	* .015	*<.01		*<.01				80	*<.01								4
1970	3	12	5	114	124	.04	<.01		<.01				68	<.01								
			6	132	140	.02	<.01		<.01				100	<.01								
	3	27	5	110	120	.01	<.01		<.01				64	<.01								
			6	132	144	.02	<.01		<.01				100	<.01								
Monthly Ave.				122	132	.02	*<.01		*<.01				83	*<.01								4
1970	4	7	5	110	120	.04	<.01		<.01				44	<.01								
			6	145	156	.01	<.01		<.01				80	<.01								
Monthly Ave.				127	138	.25	*<.01		*<.01				62	*<.01								2
1970	5	1	5	117	124	<.01	<.01		<.01				88	<.01								
			6	138	144	<.05	<.01		<.01				84	<.01								
	5	11	5	117	128	.02	<.01		<.01				100	<.01								
			6	122	128	<.01	<.01		<.01				104	<.01								
	5	11-28	1	110	129	.01	<.01		<.02			<25		<.01								
			1c	78	109	.01	<.01				62	<25	90	<.01						27		
			1f	121	150	.04	<.01				66	<25	88	<.01						25		
			2	88	122	.02	<.01				50	<25	56	<.01						21		
			3	87	111	.04	<.01				38	<25	46	<.01						24		
			4	91	126	.03	<.01				38	<25	42	<.01						30		
			5	105	129	.02	<.01		<.01		46	<25	62	<.01						26		
			6	137	150	.01	<.01		<.01		78	<25	96	<.01						27		
	5	27	5	60	92	.31	<.001	<.01	.032													
			6	69	92	<.01	<.001	<.01	<.001													
Monthly Ave.				103	124	* .04	*<.01	*<.01	*<.01		52	*<25	78	*<.01						26		14
1970	6	5	1f	84	116	.14	<.001			<.01	32		92									
			2	67	92	.13	.014			<.01	20		64									
			3	72	100	.02	<.001			<.01	28		68									
			4	74	104	.19	<.001			<.01	28		68									
			5	76	104	.15	<.001			<.01	28		64									
			6	86	112	.09	<.001			<.01	36		96									
	6	26	1	95	124		<.01					5		<.01								
			C-1	40	60		<.01					<1.5		<.01								
			1-7	90	116		<.01					3		<.01								
			2	62	88		.01					<1.5		<.01								
			3	45	72		<.01					<1.5		<.01								
			4	55	84		<.01					3		<.01								
			5	55	92		.02					3		<.01								
			6	72	112		.01					10		<.01								
Monthly Ave.				70	98	.12	*<.08			*<.01	29	* 3	75	*<.01								14

Table 29 (continued) Hydrochemistry Individual Sampling Information for the Little Boulder Creek Drainage, White Cloud Area, Idaho.

Year	Month	Day	Station	TDS	TS	TESTS Fe	Cu	Pb	Zn	Hg	Alk	Turb	Mo	Co	pH	O_2	Al	Si	Cl	Na	Number of Samples Collected Per Month & Year
1970	7	9	5	65	104	.01						2	<.01								
			3	57	80	<.01						<1	<.01								
	7	23	5	105	140	.07	<.001				36		108	<.01							
			6	111	148	.03	<.001				40		104	<.01							
Monthly Ave.				84	118	* .03	*<.001				38	* 1	106	*<.01	*<.01						4
1970	9	4	1	92	116	.01	<.001				40		96	<.01							
			1f	92	120	.10	<.001				48		88	<.01							
			1c	83	116	.03	<.001				16		80	<.01							
			2	76	108	<.01	<.001				28		80	<.01							
			3	86	120	<.01	<.001				28		88	<.01							
			4	77	112	.12	<.001				28		80	<.01							
	9	16	5	105	140	.03							<.01								
			6	154	188	.03							<.01								
Monthly Ave.				96	127	* .03	*<.001				31		85	*<.01	*<.01						8
1970	10	21	5	78	124	.01						4		<.01							
			6	111	152	.03						6		<.01							
Monthly Ave.				95	138	.02						5		*<.01							2
1970	11	18	5	114	160	.01	<.001			.0002		<1	84	<.01							
			6	158	130	.03	<.001			.0002		3	104	<.01							
Monthly Ave.				136	170	.02	<.001			.0002		2	94	*<.01							2
Yearly Ave.				98	123	* .04	*<.01	*<.01	*<.01	.0002	38	2	80	*<.01	*<.01					26	59
1971	2	17	5	112	140	.03	<.001			.0008	60	1	84								
			6	148	176	.07	<.001			.0009	80	5	100								
Monthly Ave.				130	158	.05	<.001			.0008	70	3	92								2
Yearly Ave.				130	158	.05	*<.001			.0008	70	3	92								2
Grand Ave.				100	130	* .02	*<.01	* .01	* .01	.003	46	*<25	79	*<.01	* .01	.7	9	*<1	5	30	4	110

*An approximate figure.

Table 30 Hydrochemistry Individual Sampling Information for the Big ═ Creek Drainage, White Cloud Area, Idaho

Year	Month	Day	Station		TESTS TDS	TS	Fe	Cu	Pb	Zn	Hg	Alk	Turb	Hd	Mo	Number of Samples Collected Per Month-Year
1969	12	15	2	BBC	116	120	.03	<.01		<.01				68	<.01	
			3		114	116	.01	<.01		<.01				68	<.01	
			4		127	132	.12	<.01		<.01				80	<.01	
			5		123	124	<.01	<.01		<.01				72	<.01	
			6		143	144	<.01	<.01		<.01				72	<.01	
			7		138	144	.05	<.01		<.01				80	<.01	
Monthly Ave.					126	130	* .03	*<.01		<.01				73	*<.01	6
Yearly Ave.					126	130	* .03	*<.01		<.01				73	*<.01	6
1970	1	6	2	BBC												
			3													
			4													
			5		132	136	.02	<.01		<.01				76	<.01	
			6		136	140	.01	<.01		<.01				100	<.01	
			7													
	1	19	2	BBC	107	108	<.01	<.01		<.01					<.01	
			3		117	124	.02	<.01		<.01					<.01	
			4		108	116	<.01	<.01		<.01					<.01	
			5		127	132	.02	<.01		<.01					<.01	
			6		146	148	.02	<.01		<.01					<.01	
			7		138	148	.02	<.01		<.01					<.01	
Monthly Ave.					126	131	* .01	*<.01		*<.01				88	*<.01	8
1970	2	9	2	BBC	103	108	.10	<.01		<.01				82	<.01	
			3		122	124	<.01	<.01		<.01				104	<.01	
			4		132	136	<.01	<.01		<.01				64	<.01	
			5													
			6		145	152	<.01	<.01		<.01				76	<.01	
			7		145	152	.08	<.01		<.01				84	<.01	
	2	10	6	BBC	146	148	.06	<.01		<.01				68	<.01	
	2	19	5	BBC	132	140	<.01	<.01		<.01				64	<.01	
	2	25	2	BBC	107	112	.05	<.01		<.01				68	<.01	
			3		127	132	<.01	<.01		<.01				104	<.01	
			4		116	124	.03	<.01		<.01				64	<.01	
			5		132	136	<.01	<.01		<.01				80	<.01	
			6		145	148	.02	<.01		<.01				76	<.01	
			7		136	140	.01	<.01		<.01				100	<.01	
Monthly Ave.					130	135	* .02	*<.01		*<.01				79	*<.01	13
1970	3	12	2	BBC	114	116	<.01	<.01		<.01				60	<.01	
			3		127	132	<.01	<.01		<.01				92	<.01	
			4													
			5		145	148	.06	<.01		<.01				80	<.01	
			6		146	148	.02	<.01		<.01				88	<.01	
			7		138	144	.04	<.01		<.01				84	<.01	
	3	27	2	BBC	116	124	.05	<.01		<.01				72	<.01	
			3		126	132	.11	<.01		<.01				68	<.01	
			4		124	128	.03	<.01		<.01				68	<.01	
			5		122	124	.03	<.01		<.01				60	<.01	
			6		143	152	.02	<.01		<.01				112	<.01	
			7		138	148	.03	<.01		<.01				76	<.01	
Monthly Ave.					131	136	* .04	*<.01		*<.01				78	*<.01	11

Table 30 (continued) Hydrochemistry Individual Sampling Information for the Big Boulder Creek Drainage, White Cloud Area, Idaho.

Year	Month	Day	Station		TDS	TS	Fe	Cu	Pb	Zn	Hg	Alk	Turb	Hd	Mo	Number of Samples Collected Per Month & Year
1970	4	7	2	BBC												
			3		107	112	.11	<.01		.05				68	<.01	
			4		116	120	<.01	<.01		<.01				96	<.01	
			5		118	120	<.01	<.01		<.01				104	<.01	
			6		139	140	<.01	<.01		<.01				68	<.01	
			7													
	4	9	4	BBC	104	108	<.01	<.01		<.01				52	<.01	
			7		138	144	.02	<.01		<.01				72	<.01	
Monthly Ave.					120	124	* .04	*<.01		*<.01				77	*<.01	6
1970	5	1	2	BBC	111	116	.02	<.01		<.01				76	<.01	
			3		113	116	.05	<.01		<.01				64	<.01	
			4		122	128	.01	<.01		<.01				60	<.01	
			5		107	112	<.01	<.01		<.01				80	<.01	
			6		127	136	.13	<.01		<.01				80	<.01	
			7		138	144	.05	<.01		<.01				80	<.01	
	5	11	2	BBC	96	100	.02	<.01		<.01				56		
			3		107	116	.03	<.01		<.01				64	<.01	
			4		85	96	<.01	<.01		<.01				68	<.01	
			5		122	124	.10	<.01		<.01				76	<.01	
			6		131	136	.01	<.01		<.01				68	<.01	
			7		138	144	<.01	<.01		<.01				92	<.01	
Monthly Ave.					116	122	* .03	*<.01		*<.01				72	*<.01	12
1970	10	21	1	BBC	98	106	.04	<.01					<25		<.01	
			2		98	106	.05	<.01					<25		<.01	
			3		102	120	.08	<.01					<25		<.01	
			4		113	116	.02	<.01					<25		<.01	
			5		111	130	<.01	<.01					<25		<.01	
			6		113	115	<.01	<.01					<25		<.01	
Monthly Ave.					105	115	* .02	*<.01					*<25		*<.01	6
1970	11	21	1	BBC	113	152	<.01	<.01					<25		<.01	
			2		98	100	<.01	<.01					<25		<.01	
			3		107	118	.02	<.01					<25		<.01	
			5		113	120	<.01	<.01					<25		<.01	
			6		118	150	<.01	<.01					<25		<.01	
Monthly Ave.					110	128	*<.01	*<.01					*<25		*<.01	5
Yearly Ave.					122	128	.01	<.01		<.01			<25	77	<.01	61
Grand Ave.					122	129	.01	<.01		<.01			<25	75	<.01	

*An approximate figure.

Table 31 ═══istry Individual Sampling Information for The Slate Creek Drainage, ═══ouds Area, Idaho

Year	Month	Day	Station	TESTS TDS	TS	Fe	Cu	Pb	Zn	Hg	Alk	Turb	Hd	Mo	Ag	pH	Ca	Mg	Mn	Na	Cl	SO_4	NO_3	PO_4	F	Number of Samples Collected Per Month and Year
SLATE CREEK																										
1968	10	5	CS 1				.03	<.01	.08																	
			2				.02	<.01	.11																	
			3				.04	.09	.21																	
			4				.02	<.01	.01																	
			5				.02	.32	.13																	
			6				.03	.51	<.01																	
Monthly Ave.							.03	* .15	* .09																	6
1968	11	15	CS 1				.06		<.001				172													
			2				.05		<.001				158													
			3				.05		<.001				136													
			4				.04		<.001				92													
			5				.07		<.001				128													
			6				.07		<.001				80													
Monthly Ave.							.06		*<.001				128													6
Yearly Ave.							.04	* .15	*<.03				128													12
1969	5	8	CS 1																							
			2																							
			3	140	156	.04	.03		.01		96	<25	106													
			4	113	124	.10	.01		.03		104	<25	82													
			5	115	128	.22	<.01		.02		116	<25	104													
			6	122	142	.06	<.01		.01		96	<25	100													
Monthly Ave.				122	137	.10	*<.003		.02		103	*<25	98													6
1969	7	3	CS 1	175							28		108			8.3	42	1		6	<2	30	.9	.09	.71	
			2								52		96			8.3	11	16	.34	<1	<2	29	.9	.02	.58	
			3								52		72			8.3	18	7		<1	<2	19	.9		.47	
			4								48		84			8.3	13	12		1	<2	13	.9		.06	
			5								56		76			8.3	21	6		1	<2	11	.9		<.01	
			6	125							32		75			8.3	24	4		2	<2	14	.9		.14	
	7	7	CS 1	228	240	.06					104		104		.03	8.0										
			2	220	236	.04					120		112		.03	8.0										
			3	215	220	.04					100		96		.03	8.0										
			4	192	200	.02					60		86		.04	8.0										
			5	197	208	.02					88		88		.02	8.0										
			6	159	172	<.01					72		76		.01	8.0										
Monthly Ave.				189	213	* .04					69		90		.03	8.2	21	8	.34	*2	*<2	19	.9	.05	.33	12
1969	8	19	CS 1	230	242	.02	<.01					<25		<.01												
			2	250	272	.01	<.01					<25		<.01												
			3																							
			4	215	256	<.01	<.01					<25		<.01												
			5	145	176	<.01	<.01					<25		<.01												
			6	138	154	<.01	<.01					<25		<.01												
Monthly Ave.				196	220	* .009	*<.01					*<25		*<.01												6
1969	11		CS 1	219	252	<.01	<.001	<.01	.001																	
			2	157	204	<.01	<.001	<.01	.001																	
			3	170	208	.01	<.001	<.01	.002																	
			4	170	200	<.01	<.001	<.01	<.001																	
			5	203	248	<.01	<.001	<.01	.005																	
			6	146	188	.01	<.001	<.01	<.001																	
Monthly Ave.				179	217	*<.01	*<.001	*<.01	*<.003																	6
1969	12	18	CS 1	222	244	.01	<.001	<.01	<.001																	
			2	215	228	.04	<.001	<.01	.006																	
			3	215	236	<.01	<.001	<.01	.003																	
			4	200	224	.03	<.001	<.01	.015																	
			5	172	208	.07	<.001	<.01	.024																	
			6	102	140	.01	<.001	<.01	.006																	
Monthly Ave.				188	213	* .03	*<.001	*<.01	* .010																	6
Yearly Ave.				179	204	* .03	*<.004	*<.01	* .008		78	*<25	92	*<.01	.03	8.2	21	8	.34	*2	*<2	19	.9	.05	.33	36

Table 31 (continued) Hydrochemistry Individual Sampling Information for the Slate Creek Drainage, White Clouds Area, Idaho.

Year	Month	Day	Station	TDS	TS	Fe	Cu	Pb	Zn	Hg	Alk	Turb	Hd	Mo	Ag	pH	Ca	Mg	Mn	Na	Cl	SO_4	NO_3	PO_4	F	Number of Samples Collected Per Month & Year
1970	12	18	CS 1	212	296	.03	<.001			.0002		11	168	<.01												
			2	206	268	.05	<.001			.0008		10	152	<.01												
			3	200	268	.03	<.001			.0005		9	144	<.01												
			4	180	272	<.01	<.01	<.01		.0005		7			<.01											
			5	194	220	<.01	<.001			.0002		12	132	<.01												
			6	140	152	<.04	<.001					5	112	<.01												
Monthly Ave.				189	246	* .03	*<.001	*<.01		.0004		9	142	*<.01	*<.01											6
Yearly Ave.				189	246	* .03	*<.001	*<.01		.0004		9	142	*<.01	*<.01											6
1971	2	17	CS 1	196	336	.08	<.001			.0005		17	136													
			2	214	300	.05	<.001			.0014		13	132													
			3	210	356	.13	<.007			<.0002		14	120													
			4	192	324	.10	<.001			.0005		8	92													
			5	210	360	.19	<.001			.0009		15	128													
			6	156	252	.02	<.001			.0002		10	112													
Monthly Ave.				196	321	.09	*<.001			* .0006		13	120													6
Yearly Ave.				196	321	* .09	*<.001			* .0005		13	120													
Grand Ave.				183	228	* .05	*<.01	* .05	* .02*	.0005	78	11	111	*<.01	.02	8.2	21	8	.34	*2	*<2	19	.9	.05	.33	60
[illegible] CREEK																										
1969	2	7	CS 1	124	140	.08	.01				68		60		.01											
	2	14	CS 1				<.02		<.01			<25	140													
	5	8	CS 1	125	33	.12	.07		.03		92	<25	64													
	8	19	CS 1	127	132	<.02	<.01					<25	<.01													
	10	30	CS 1	113	144	<.04	<.01		.01			<25														
Yearly Ave.				122	126	* .06	* .004		* .01		80	*<25	* 66		.01											
Grand Ave.				122	126	* .06	* .004		* .01		80	* 25	* 66		.01											5
SILVER RULE CREEK																										
1969	2	14	CS 1			<.01	.02					<25	140													
	5	8	CS 1	125	142	.02	.03		.02		112	<25	108													
	7	7	CS 1	202	210	.03	.01				96		92		.01											
	8	19	CS 1	203	300	.02	<.01					<25		<.01												
	10	30	CS 1	145	208	<.01	.01		<.01			<25														
	11		CS 1A	200	224	.11	<.001	<.01	.004																	
Yearly Ave.				115	217	* .03	* .001	<.01	.010		104	*<25	113	*<.01	.01											
Grand Ave.				115	217	* .03	* .001	<.01	.010		104	*<25	113	*<.01	.01											

*An approximate figure.

**Table 32 Hydrochemistry Individual Sampling Information for The Slate Creek Drainage, White Clouds Area, Idaho

Year	Month	Day	Station	pH	TDS	TS	Alk	Hd	Ca	Mg	Fe	Mn	Na	Cl	SO_4	NO_2	PO_4	TESTS P	N	Zn	Cu	As	Ba	Cd	Pb	Boron	Potassium
1970	6	30	43 P	8	188	252	88	140	30	26	.85	.04	1	6	7	1.0	.06	<.01	.99	.08	<.01	<.01	<.10	<.01	.03	6	2
			42 P					5600	1720	312	117	.50	148	400	125		325	41		42	1	<.01	<.01	.35	27	42	204
			41 P	8	265	304	100	204	54	36	.38	<.01	2	4	28	.5	.08	.11	.54	<.01	<.01	<.01	<.01	<.01	<.01	3	3
			40 P	8	107	136	68	72	19	13	2	.21	2	4	5	2	.14	.20	.57	.08	.04	<.01	<.01	<.01	.04	3	<1
			39 P	8	92	124	48	48	18	7	1	<.01	<1	4	4	1	.09	.23	.50	<.01	<.01	<.01	<.01	.01	.27	<1	<1
			38 P	8	235	288	108	136	38	24	6	1	12	8	11	1	.27	.20	.10	.10	.05	<.01	<.01	.02	<.01	25	8
			37 P	8	210	260	104	120	32	21	.85	.02	2	6	6	1	.25	.06	.54	<.01	.01	<.01	<.01	<.01	<.01	2	<1
			36 P	8	206	252	100	116	32	20	1	.05	4	4	5	.7	.09	.13	.47	<.01	<.01	<.01	<.01	.01	<.01	<1	2
			35 P	8	195	224	92	140	35	25	.55	<.01	2	14	3	.8	.03	<.01	.46	<.01	<.01	<.01	<.01	.01	<.01	20	1
			34 P	8	195	232	96	128	37	20	.46	.02	1	8	3	.5	.05	.18	.49	<.01	<.01	<.01	<.01	.01	<.01	2	1
			33 P	8	202	236	96	160	37	30	.58	<.01	2	8	4	1	.14	.53	.49	<.01	.02	<.01	<.01	<.01	<.01	<1	1
			32 P	8	230	262	108	140	40	24	3	.30	6	8	8	.7	.11	.46	.50	.25	<.01	<.01	<.01	.01	.02	<1	4
			31 P	8	256	288	108	164	46	28	5	.88	2	4	15	1	.35	.06	.57	.49	.03	<.01	<.01	.04	.26	7	5
			30 P	8	235	276	112	144	45	24	3	.59	4	8	11	1	.17	.37	.54	.33	.06	<.01	<.01	.03	.20	6	8

**Analyzed by The Idaho Department of Health.

Table 33 Monthly, Yearly, and Total Hydrochemistry Averages of the Big Boulder, Little Boulder, and Slate Creek Drainages, White Clouds Area, Idaho

Year			TESTS TDS	TS	Fe	Cu	Pb	Zn	Hg	Alk	Turb	Hd	Mo	Co	pH	O_2	Al	Si	Cl	Na	Ag	Ca	Mg	Mn	SO_4	NO_3	PO_4	F	Number of Samples Per Month & Year
BIG BOULDER CREEK																													
1969		December	126	130	.03	<.01		<.01				73	<.01																6
	1969	Average	126	130	.03	<.01		<.01				73	<.01																6
1970		January	126	131	.01	<.01		<.01				88	<.01																8
		February	130	135	.02	<.01		<.01				79	<.01																13
		March	131	136	.04	<.01		<.01				78	<.01																11
		April	120	124	.04	<.01		<.01				77	<.01																6
		May	116	122	.03	<.01		<.01				72	<.01																12
		October	105	115	.02	<.01					<25		<.01																6
		November	110	128	<.01	<.01					<25		<.01																5
	1970	Average	122	128	<.01	<.01		<.01			<25	77	<.01																61
Grand Average			122	129	.01	<.01		<.01			*<25	75	<.01																67
LITTLE BOULDER CREEK																													
1969		May													.7	9													5
		July	97	115	*<.01	*<.01				58	*<25	73	*<.01				<.1	5	30	4									13
		August	98	147	*<.01	*<.01					*<25		*<.01																15
		September	103	137	* .04	*<.01					*<25		*<.01																15
		October	107	118		*<.01	.02				*<25																		1
	1969	Average	99	133	* .02	*<.01	.02			58	*<25	73	*<.01	* .01	.7	9	*<.1	5	30	4									49
1970		January	122	132	*<.01	*<.01		*<.01				72	*<.01																5
		February	132	136	* .015	*<.01		*<.01				80	*<.01																4
		March	122	132	.02	*<.01		*<.01				83	*<.01																4
		April	127	138	.25	*<.01		*<.01				62	*<.01																2
		May	103	124	* .04	*<.01	*<.01	*<.01		52	*<25	78	*<.01						26										14
		June	70	98	.12	*<.08			*<.01	29	* 3	75	*<.01																14
		July	84	118	* .03	*<.001				38	* 1	106	*<.01	* .01															2
		September	96	127	* .03	*<.001				31		85	*<.01	*<.01															4
		October	95	138	.02						5		*<.01																8
		November	136	170	* .02	*<.001			.0002		2	94	*<.01																2
	1970	Average	96	123	* .04	*<.01	*<.01	<.01	.0002	38	2	80	*<.01	*<.01					26										59
1971		February	130	158	.05	* .001			.0008	70	3	92																	2
	1971	Average	130	158	.05	* .001			.0008	70	3	92																	2
Grand Average			100	130	* .02	*<.01	* .01	* .01	.003	46	*<25	79	*<.01	*..01	.7	9	*<.1	5	30	4									110
SLATE, SILVER BELT, AND CARBONATE CREEKS																													
1968		October				.03	* .15	* .09																					
		[illegible]ber				.06		*<.001				129																	6
	1968	Average				.04	* .15	* .03				129																	6
1969		May	122	137	.10	* .003		.02		103	*<25	98																	12
		July	189	213	* .04					69		90			8.2				*<2	*2	.03	21	8	.34	19	.9	.05	33	6
		August	196	220	* .009	*<.01					*<25		*<.01																12
		November	179	217	*<.01	*<.001	*<.01	* .003																					6
		December	188	213	* .03	*<.001	*<.01	* .010																					6
	1969	Average	179	204	* .03	* .004	*<.01	* .008		78	*<25	92	*<.01		8.2				*<2	*2	.03	21	8	.34	19	.9	.05	33	6
1970		December	189	246	* .03	* .001	*<.01		.0004		9	142	*<.01								.01								36
	1970	Average	189	246	* .03	* .001	*<.01		.0004		9	142	*<.01								.01								6
1971		February	196	321	.09	*<.001			* .0006		13	120									.01								6
	1971	Average	196	321	.09	*<.001			* .0006		13	120									.01								6
Grand Average			183	228	* .05	*<.01	* .05	* .02	* .0005	78	11	111	*<.01		8.2				*<2	*2	.02	21	8	.34	19	.9	.05	33	60
SILVER BELT CREEK																													
1969	1969	Average	115	217	* .03	* .001	<.01	<.010		104	*<25	113	*<.01								.01								6
Grand Average			115	217	* .03	* .001	<.01	<.010		104	*<25	113	*<.01								.01								6
CARBONATE CREEK																													
1969	1969	Average	122	126	* .06	* .004		* .01		80	*<25	* 66									.01								5
Grand Average			122	126	* .06	* .004		* .01		80	*<25	* 66									.01								5

Table 34

Water Quality Analysis Results for Basin Creek Drainage
Samples Collected April 30, 1968 (ppm)

Station	TDS	Hdns	Ca	Mg	Fe	Mn	Na	Cl	SO4	PO4	F	Cu	Pb	Tu	Ju
1B (Basin Creek-Mouth)	56	48	21	0	.28	.016	7	4	8	.03	.39	.022	.14	<5	<25
2B (Coal Creek)	86	<10	0	<2	.07	.013	1	6	8	.03	.13	.015	.10	<5	<25
3B (East Basin)	56	16	17	0	.20	.011	9	4	8	.03	.11	.016	.07	<5	<25
4B (Short Creek)	76	72	26	2	.29	.020	8	4	8	.03	.39	.021	.03	<5	<25
5B (Noho Creek)	82	68	30	0	.37	.024	7	4	8	.03	.28	.010	.11	<5	<25
6B (Kelly Creek)	48	32	11	1	.88	.015	5	4	8	.03	.53	.023	.09	<5	<25
7B (Hay Creek)	60	76	16	9	.49	.009	10	6	8	.03	.32	.026	.08	<5	<25
8B (Basin Creek above confluence Hay Creek)	52	28	16	0	.51	.009	5	4	8	.03	.16	.025	.07	<5	<25
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average	64	44	19	1.7	.38	.014	6.5	4.5	8	.03	.29	.02	.09	<5	<25

Table 35

Water Radiation Analysis for the
Basin Creek Drainage Collected April 30, 1968

Station	Alpha	Beta
Composite #1	.5 pci/L	3.0 pci/L
Hay Creek (7B) No Ho Creek (5B) Kelly Creek (6B) Short Creek (4B)		
Composite #2		
East Basin (3B) Coal Creek (2B) Basin Above (8B) Basin Mouth (1B)	.95 pci/L	5.4 pci/L

Table 36

Basin Creek Drainage pH Readings
in Units, August 1968

Station	pH
Hay Creek (7B)	7.2
Basin Above (8B)	7.2
Kelly Creek (6B)	7.5
Short Creek (4B)	7.2
No Ho (5B)	7.5
East Fork (3B)	7.5
Coal Creek (2B)	7.5
Basin Mouth (1B)	7.5

Table 37

Basin Creek Drainage pH and Hardness
in Units and ppm Respectively, August 1, 1969

Stream Station Transect	pH	Hardness
1	7.5	40
2	7.5	39
3	7.5	39
4	7.5	40
5	7.5	38
6	7.5	36
7	---	--
8	---	--
Hay Creek (mouth)	7.9	56
Short Creek (mouth)	7.5	73
Kelly Creek (mouth)	7.5	38

Table 38

A Summary of Aquatic Habitat Survey Data for
Basin Creek (Tributary Salmon River) August 1969

Station	Stream			Pool		Streambed Surface Composition				Banks		
	Width (ft)	Depth (in)	Riffle (ft)	Width (ft)	Rating	Boulder	Rubble	Gravel	Sediment (Percent	Environment	Stability	Class
1	35	10	32	3	2.4	10	36	52	2	.9	1.1	1.3
2	28	12	25	3	2.7	34	39	27	0	1.0	.8	1.4
4	28	9	24	4	3.8	14	51	71	4	1.2	.9	1.3
5	18	9	15	4	4.2	31	31	38	0	1.3	1.5	1.8
6	24	12	15	9	1.5	18	30	42	10	1.4	1.4	1.6
7	24	10	21	4	1.3	10	46	38	6	1.3	1.6	1.8
8	19	9	17	2	4.3	33	37	27	3	2.0	1.8	2.0
Average	25	10	21	4	2.8	21	38	42	3	1.3	1.3	1.6

20 boulder pools
8 bark pools
4 log pools
17% clinging aquatics

3*	13	6	11	2	4.1	14	32	54	0	1.6	1.6	1.7

*East Basin Creek Station

Table 39

Basin Creek Chemical and Physical Analysis,
November 1969

Station	J+U	TS	TDS	Fe
1B	4	88	55	<.02
2B	16	39	71	.25
3B	0	78	47	.21
4B	8	102	69	.05
5B	8	75	83	<.02
6B	8	69	62	.04
7B	8	81	54	.02
8B	6	30	46	.06
Average	7	70	60	.08

Table 40 MISCELLANEOUS HYDROCHEMISTRY INFORMATION OF LAKES IN THE WHITE CLOUDS STUDY AREA

Date	Lake	TEST			
		Hd	Methyl Alk.	Pheno Alk.	ph
7/31/71	Crater	68	76.5 ppm		7.7
7/31/71	Hoodoo	55	76.5 ppm		8.0
7/29/71	Lower Ocalkens	68	85.0 ppm		8.2
7/31/71	Sullivan	68	93.0 ppm	34.0 ppm	9.5
7/30/71	Upper Ocalkens	85	76.5 ppm		7.7

APPENDIX I

Miscellaneous lake environment survey sheets.

Pioneers

Bend

Boo

Clear

White Clouds

Ocalkens Upper

Hoodo

Ocalkens Lower

Sullivan

Crater

LAKE HABITAT INVENTORY

Lake Bend Land Area Pioneers (East) Date Aug. 21, 1971

PROJ No. CVQ-9W-79 Geology _____ Parent Materials _____

Location: Sec. ____ T. ____ R. ____ Drainage Broad Canyon

Accessibility _____ Elevation _____

Water Level Fluctuation Fairly stable -down inches (stable,unstable, drys up,etc.) Lake Land Type Cirque (cirque,moraine,etc.)

Inlet Keeps - no spawning (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet goes dry - no spawning Natural Reproduction none

Type of Shoreline 80% sod; 20% rock (soil,rock,vegetation,etc.) Type of Shoal Area 80% soil 20% rock (rock, soil, etc.)

Aquatic Plants none Terrestrial Plants grasses-pines (shoreline)

Fish Food low Fish Species cutthroat

Fish Size and Condition stunted - overstocked

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres _____ Estimated Capacity _____ (horse days)

Potential Recreation Developments (outline on photo)

Acres _____ Safe Drinking Water stream from Betty Lake (location)

Recommendations Lower stocking rate

F.-2600-1

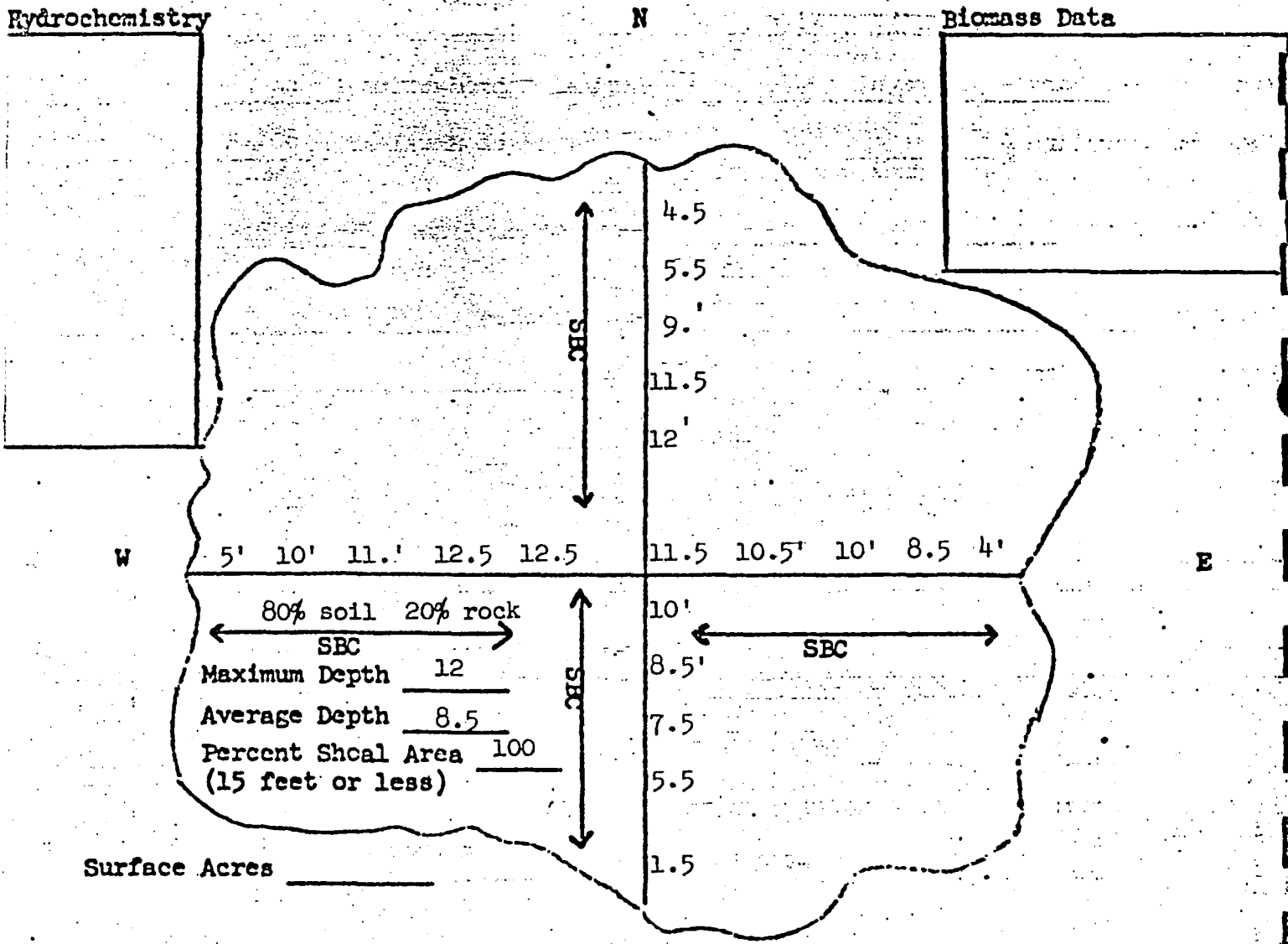
Remarks Very small watershed - some colloids

Depth measurements, ten at equal distance north to south and 10 equal distance east to west

Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

Biomass Data



Surface Acres _____

Examiner(s) /s/ Platts - Guilter

LAKE HABITAT INVENTORY

Lake Boo Land Area Pioneers (East) Date August 21, 1971

Photo No. CVQ-9W-79 Geology _____ Parent Materials _____

Location: Sec. ____ T. ____ R. ____ Drainage Broad Canyon (Copper Basin)

Accessibility Trail Elevation 10,100

Water Level Fluctuation Stable (stable, unstable, drys up, etc.) Lake Land Type Cirque-Moraine (cirque, moraine, etc.)

Inlet .5 cfs (minor spawning potential) (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet .5 cfs good gravel 30 yards Natural Reproduction _____

Type of Shoreline 50% grass/50% boulder (soil, rock, vegetation, etc.) Type of Shoal Area 65% sand; 35% boulder (rock, soil, etc.)

Aquatic Plants none Terrestrial Plants grasses (shoreline)

Fish Food low Fish Species none

Fish Size and Condition none (probably winterkill)

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres _____ Estimated Capacity _____ (horse days)

Potential Recreation Developments (outline on photo)

Acres _____ Safe Drinking Water Spring est side.. (location)

Recommendations Too shallow doesn't lend itself to feasible rehabilitation.

FS-2600-1

Remarks Little chance to developee into Fishery
Lakes snow avalanch from North Side

Depth measurements, ten at equal distance north to south and 10 equal distance east to west

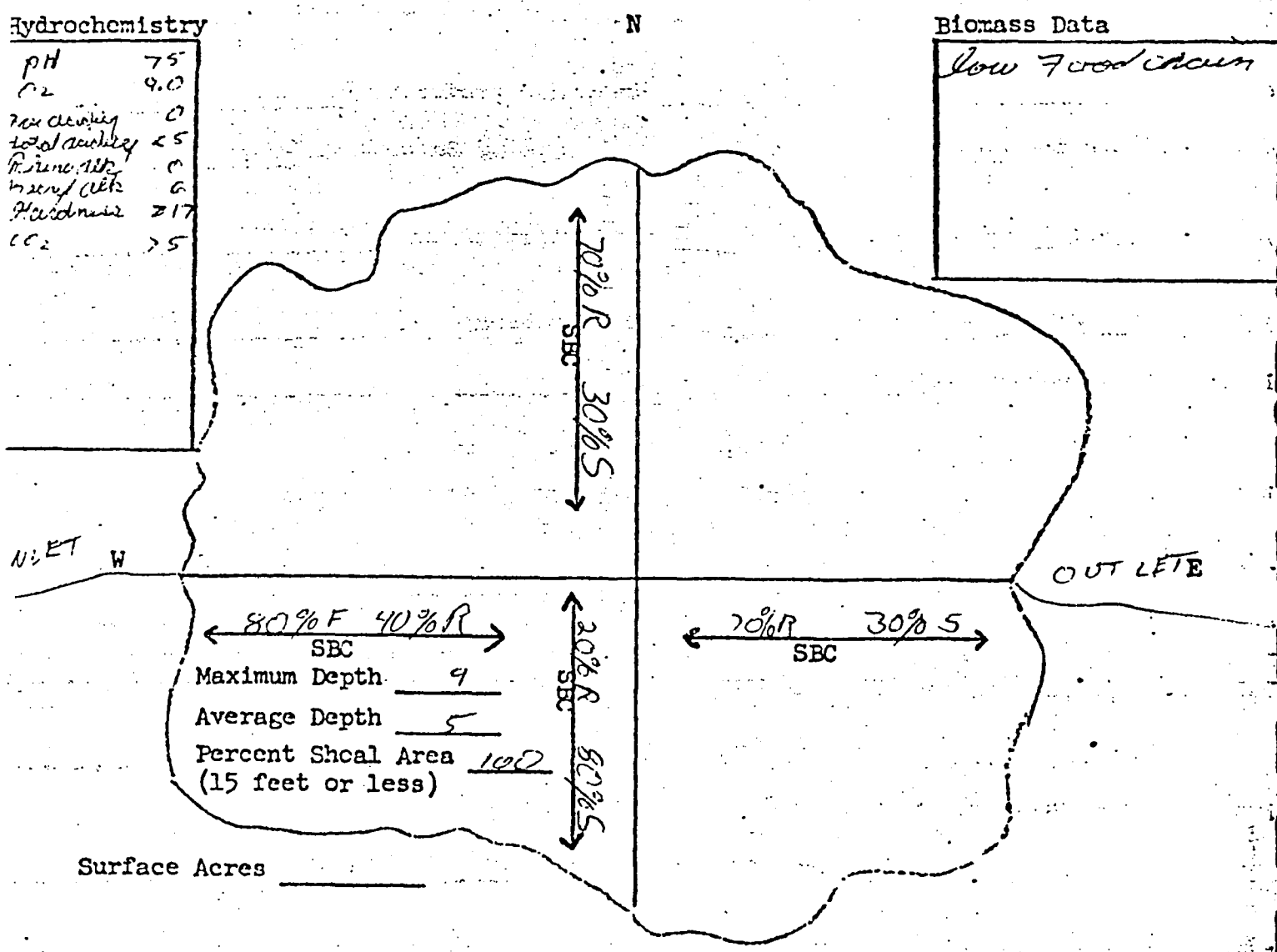
Shoal bottom composition transects (SBC). Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

pH	7.5
O_2	9.0
Nox alkalinity	0
total acidity	< 5
Fe ions mg/l	0
Mn ions mg/l	0
Hardness	≥ 17
CO_2	> 5

Biomass Data

Low Food chain



Surface Acres _____

Examiner(s) PLATTS
(signature)

LAKE HABITAT INVENTORY

Lake Clear Land Area Pioneers (East) Date Aug. 21, 1971

Fish No. CVO-SW-79 Geology _____ Parent Materials _____

Location: Sec. ____ T. ____ R. ____ Drainage Broad Canyon (Copper Basin)

Accessibility Trail Elevation 9,700

Water Level Fluctuation unstable (stable, unstable, drys up, etc.) Lake Land Type Cirque debris deposit (cirque, moraine, etc.)

Inlet None - No (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet None Natural Reproduction None

Type of Shoreline 20 grass; 20 boulder; 40 gravel; 20 soil (soil, rock, vegetation, etc.) Type of Shoal Area 50 rock; 50 soil (rock, soil, etc.)

Aquatic Plants 25% rooted Terrestrial Plants grasses - pines (shoreline)

Fish Food abundant Fish Species none

Fish Size and Condition none

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres _____ Estimated Capacity _____ (horse days)

Potential Recreation Developments (outline on photo)

Acres _____ Safe Drinking Water Stream to east (location)

Recommendations The stream from Bend Lake could be diverted into the lake used in possible fishery. Could go dry under present conditions - some years dry.

F.-2600-1

Remarks Has abundant rooted aquatic, quite fertile due to low exchange. Has supported fish in the past. Looks like creek left channel and by-passed lake. Sheep damage in past has hurt the area around it causing heavy sedimentation.

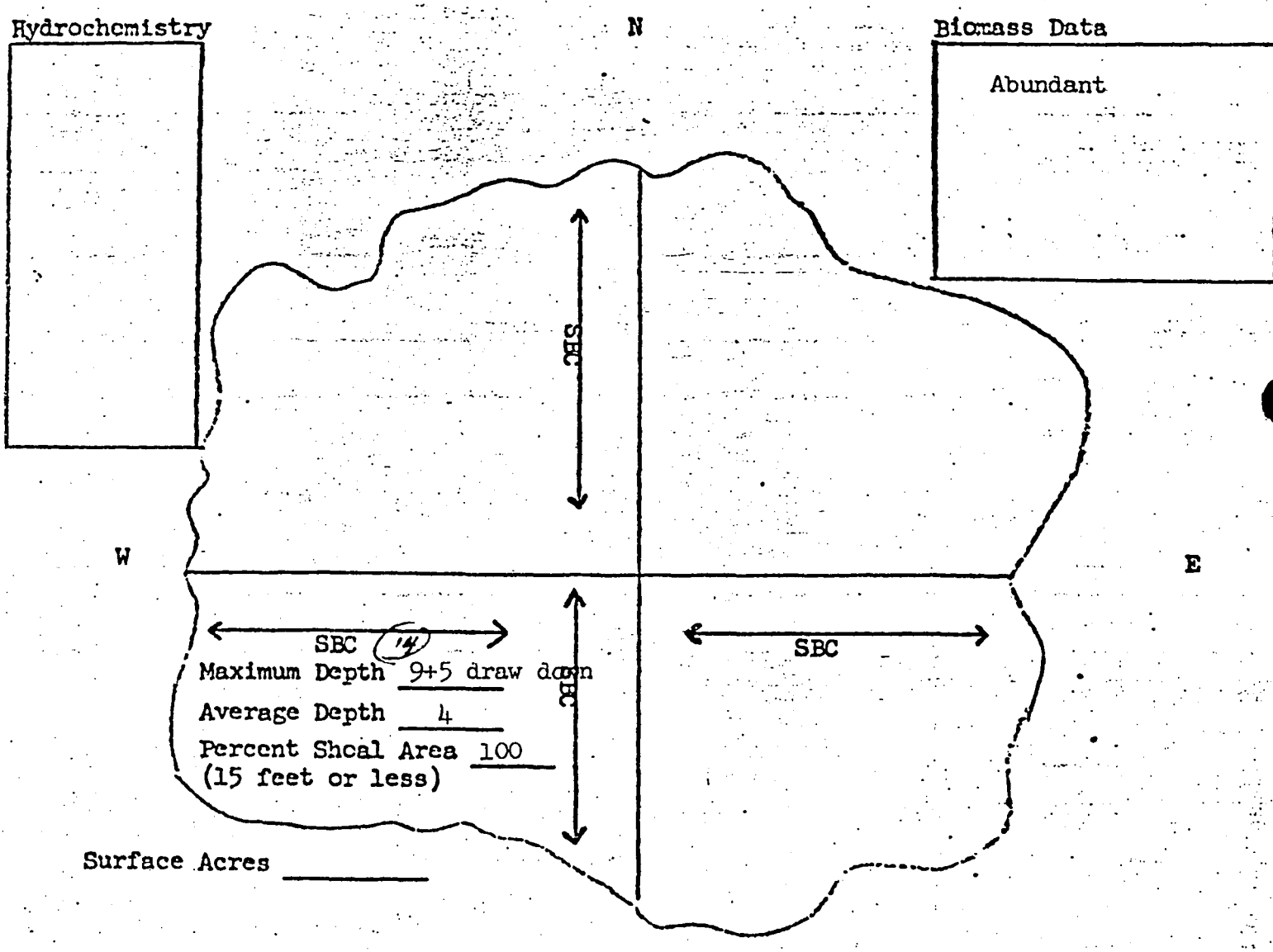
Depth measurements, ten at equal distance north to south and 10 equal distance east to west

Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

Biomass Data

Abundant



Examiner(s) _____

LAKE HABITAT INVENTORY

Lake Upper Ocalkens Land Area White Clouds Date 31 July 1971

Pt— No. EVD28-165 Geology _____ Parent Materials Metamorphic

Location: Sec. 12 T. 9N R. 15E Drainage Slate Creek

Accessibility Trail from Hoodo Mine Elevation 9,020

Water Level Fluctuation Stable (stable,unstable, drys up,etc.) Lake Land Type Moraine (cirque,moraine,etc.)

Inlet no spawning potential (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet good flow Natural Reproduction possible

Type of Shoreline 90 veg, 10 R (soil,rock,vegetation,etc.) Type of Shoal Area 85S 15R (rock, soil, etc.)

Aquatic Plants Some rooted pondweed Terrestrial Plants White bark pine, syringa, (shoreline) grass

Fish Food number crustacean Fish Species none observed

Fish Size and Condition _____

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres _____ Estimated Capacity _____ (horse days)

Potential Recreation Developments (outline on photo)

Acres 1/2 Safe Drinking Water Inlet (location)

Recommendations 3' dam on outlet would make this a superb fishery.

FT.-2600-1

Remarks May have winterkilled.

Depth measurements, ten at equal distance north to south and 10 equal distance east to west

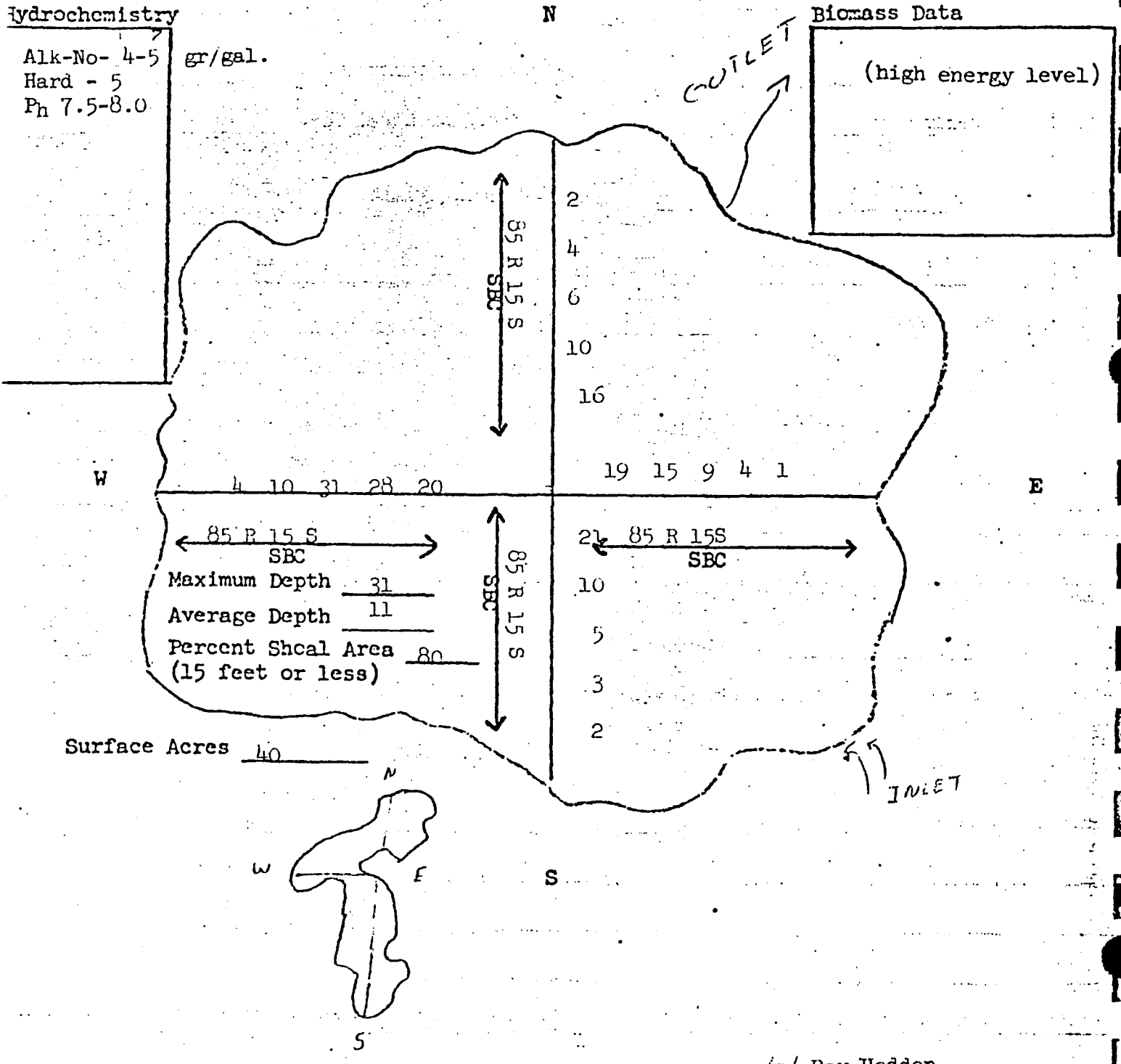
Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

Alk-No- 4-5 gr/gal.
Hard - 5
Ph 7.5-8.0

Biomass Data

(high energy level)



Examiner(s) /s/ Roy Hedden
(signature)

LAKE HABITAT INVENTORY

Lake Hoodoo Land Area White Clouds Date 31 July 1971

Photo No. EVD-28-163 Geology _____ Parent Materials Metamorphic

Location: Sec. ____ T. ____ R. ____ Drainage Hoodoo (Slate) Creek

Accessibility Trail from Hoodoo Mine Elevation _____

Water Level Fluctuation Stable (stable, unstable, drys up, etc.) Lake Land Type cirque (cirque, moraine, etc.)

Inlet No spawning (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet Little spawning potential Natural Reproduction none

Type of Shoreline 50 R 50 Veg. (soil, rock, vegetation, etc.) Type of Shoal Area 50 R 50 S (rock, soil, etc.)

Aquatic Plants little algae Terrestrial Plants White bark pine, grass (shoreline)

Fish Food few crustaceans & insects Fish Species none observed

Fish Size and Condition unknown

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres 3 Estimated Capacity - (horse days)

Potential Recreation Developments (outline on photo)

Acres 0 Safe Drinking Water - (location)

Recommendations continue to stock as before.

Remarks **depth measurements questionable due to unforeseen circumstances.

Depth measurements, ten at equal distance north to south and 10 equal distance east to west

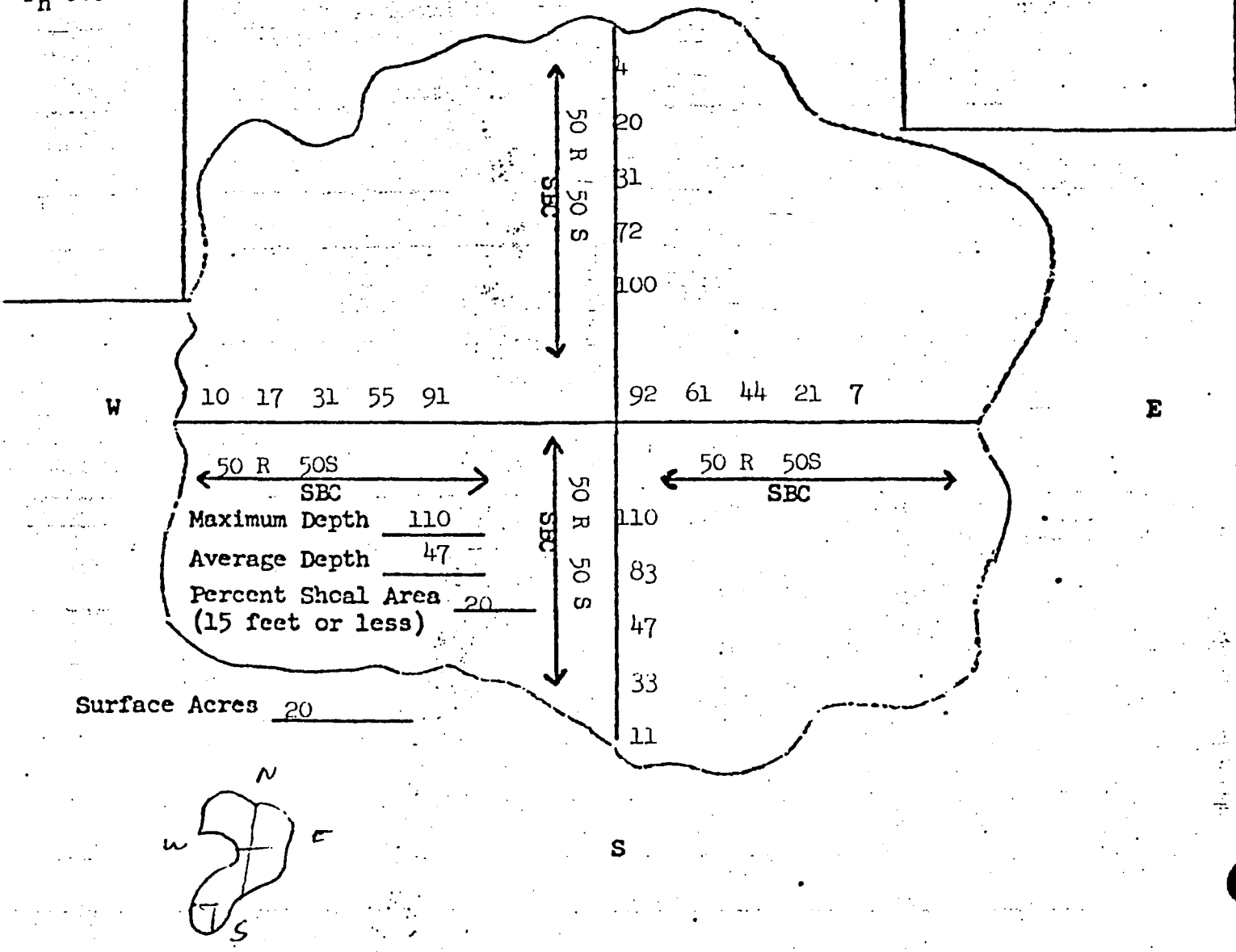
Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

Alk-No-4-5 gr/gal.
Hard -5 " "
P_h-8.0

Biomass Data

(low energy flow)



Examiner(s) /s/ Roy Hedden

LAKE HABITAT INVENTORY

Lake Lower Ocalken Land Area White Clouds Date 31 July 1971

Photo No. EVD-28-165 Geology _____ Parent Materials Metamorphic

Location: Sec. 12 T. 9N R. 15E Drainage Slate Creek

Accessibility Trail from Hoodoo Mine Elevation 8,872

Water Level Fluctuation Stable (stable, unstable, drys up, etc.) Lake Land Type Moraine (cirque, moraine, etc.)

Inlet Some spawning potential (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet Little spawn potential Natural Reproduction none observed

Type of Shoreline 30 R 70 veg. (soil, rock, vegetation, etc.) Type of Shoal Area 80S 20 R (rock, soil, etc.)

Aquatic Plants Little algae Terrestrial Plants Whitebark pine, grass (shoreline)

Fish Food few insects & crustaceans Fish Species none observed

Fish Size and Condition _____

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres - Estimated Capacity - (horse days)

Potential Recreation Developments (outline on photo)

Acres 1 Safe Drinking Water Inlet and outlet. (location)

Recommendations none

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Remarks not as potentially productive as upper lake

Depth measurements, ten at equal distance north to south and 10 equal distance east to west

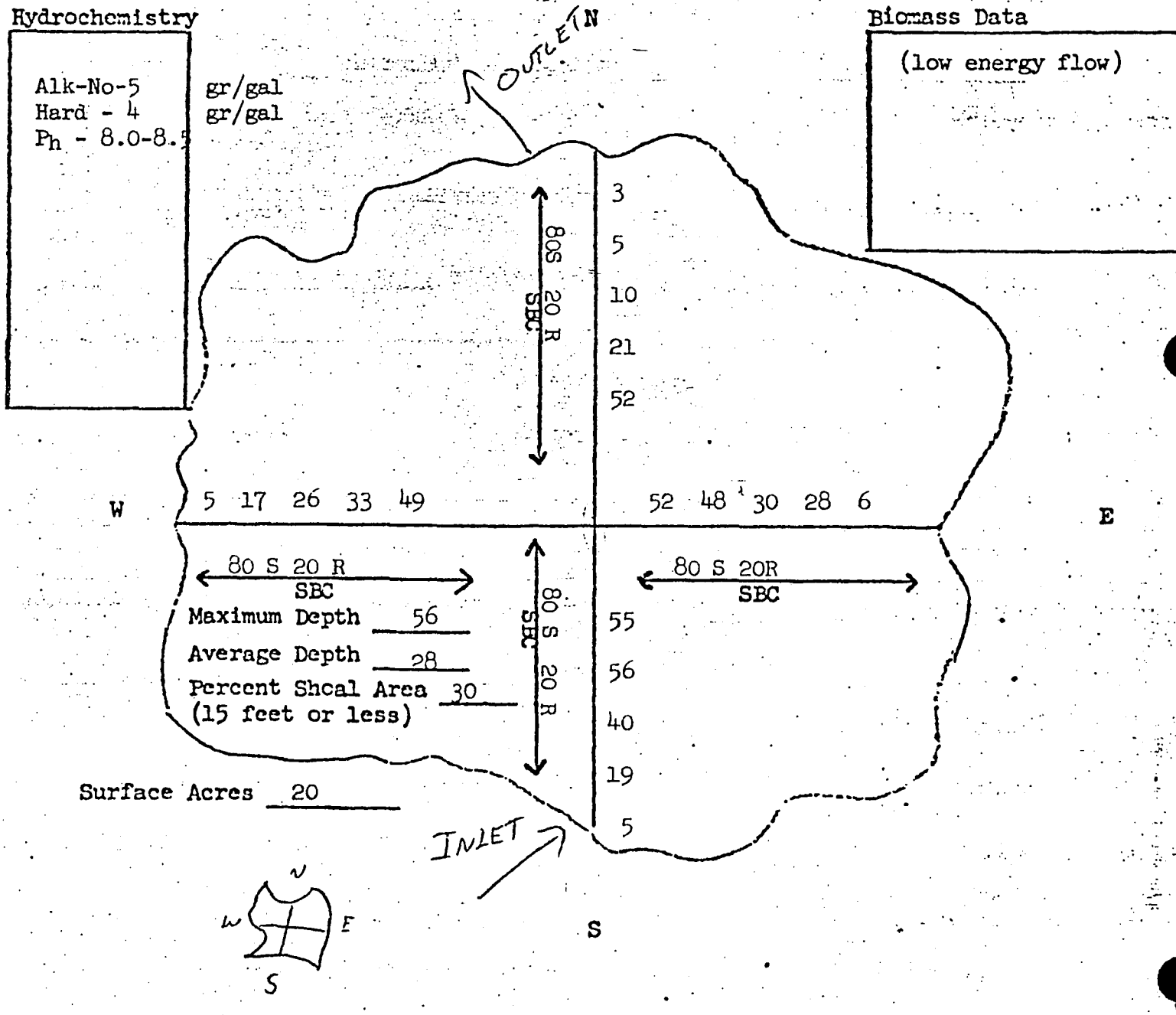
Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

Alk-No-5 gr/gal
Hard - 4 gr/gal
Ph - 8.0-8.5

Biomass Data

(low energy flow)



Maximum Depth 56

Average Depth 28

Percent Shoal Area 30
(15 feet or less)

Surface Acres 20

Examiner(s) /s/ Roy Hedden

LAKE HABITAT INVENTORY

Name Sullivan Land Area White Clouds Date 29 July 1971

Photo No. EQX-15-83 Geology _____ Parent Materials Metamorphic

Location: Sec. 3 T. 10N R. 17E Drainage Sullivan Creek

Accessibility Trail from Sullivan Hot Springs Elevation 5.65-

Water Level Fluctuation Stable (stable, unstable, drys up, etc.) Lake Land Type Moraine (cirque, moraine, etc.)

Inlet slight spawning potential (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet small, some potential Natural Reproduction none

Type of Shoreline grass & brush (soil, rock, vegetation, etc.) Type of Shoal Area 90 soil 10 rock (rock, soil, etc.)

Aquatic Plants carex, various algae Terrestrial Plants Salix, ribes, grasses (shoreline)
almost 90% of the bottom is covered with an elodea lilly rooted pondweed.

Fish Food abundant aquatic insects and crustaceans. Fish Species none

Fish Size and Condition _____

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres ½ Estimated Capacity 2 (horse days)

Potential Recreation Developments (outline on photo) Shoreline outlet & inlets

Acres _____ Safe Drinking Water _____ (location)

Recommendations a four foot dam would raise the level of the lake sufficiently to make it a fishery. Problem: Sedimentation would continue at a high rate.

:marks The lake at one time supported a fish population according to the natives but this is doubtful. The reason the lake will not support a fishery is due to its filling with sediment. Lake supports a waterfowl population.

:pth measurements, ten at equal .stance north to south and 10 ;ual distance east to west

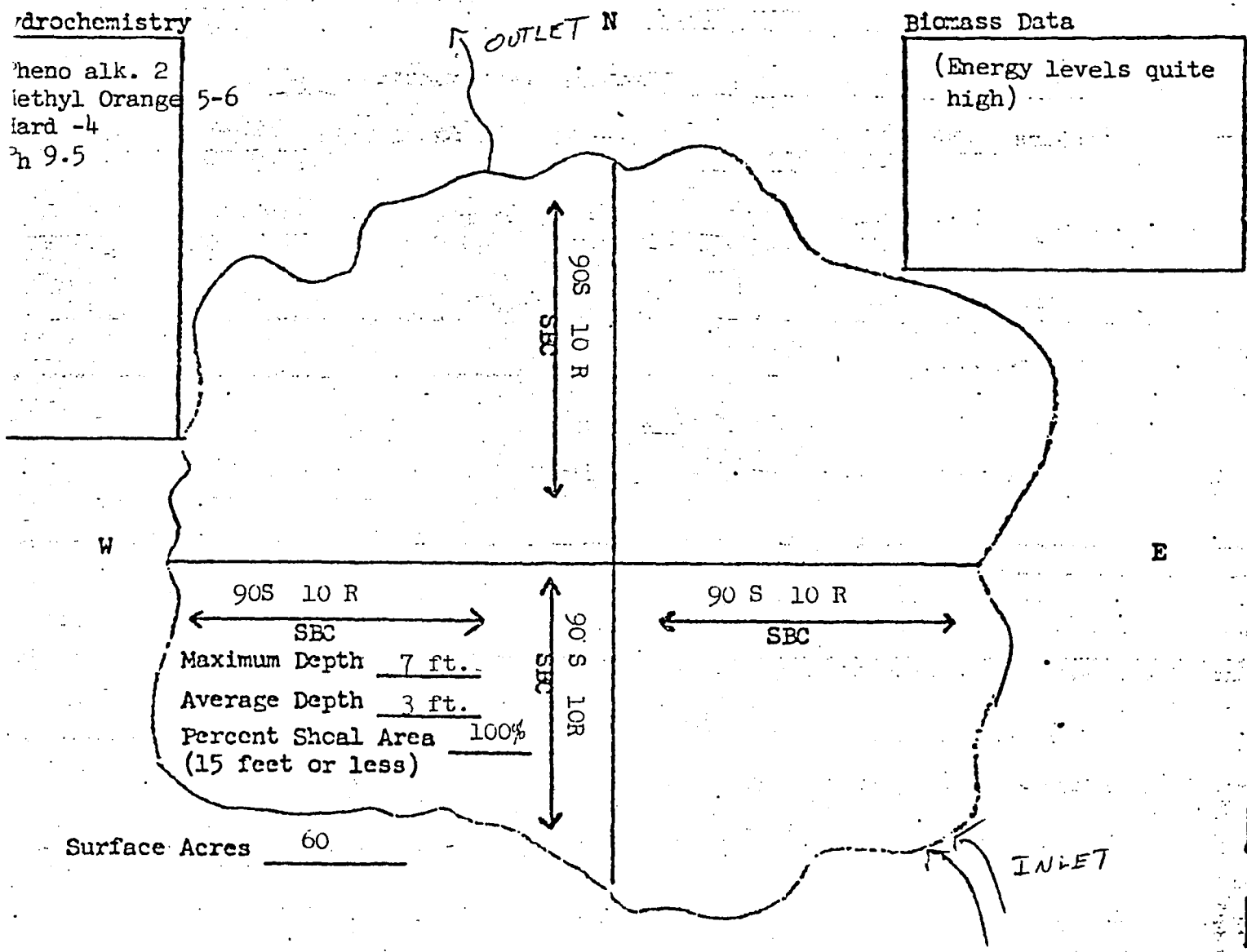
Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

/drochemistry

'heno alk. 2
iethyl Orange 5-6
lard -4
'h 9.5

Biomass Data

(Energy levels quite high)



Examiner(s) /s/ Roy Hedden

LAKE HABITAT INVENTORY

Lake Crater Land Area White Clouds Date 30 July 1971

Lake No. EVD-28-206 Geology _____ Parent Materials Metamorphic

Location: Sec. 5 T. 9 N R. 16E Drainage Livingston (Slate) Creek

Accessibility Road (trail) up Slate Creek Elevation 8919

Water Level Fluctuation Stable (stable, unstable, drys up, etc.) Lake Land Type Cirque (cirque, moraine, etc.)

Inlet large flow, little spawning (flow, spawning potential, fish accessibility) Drainage Land Types _____ (104, 111, etc.)

Outlet Little spawning potential Natural Reproduction doubtful

Type of Shoreline 50 R 50 Veg (soil, rock, vegetation, etc.) Type of Shoal Area 90R 10S (rock, soil, etc.)

Aquatic Plants None observed Terrestrial Plants grass, white bark pine (shoreline)

Fish Food Insects (surface) very little bottom food Fish Species cutthroat

Fish Size and Condition 8" - 12" good

STOCKING DATA

Date	Species	Number	Success

Pack Stock Forage (outline on photo)

Acres 0 Estimated Capacity _____ (horse days)

Potential Recreation Developments (outline on photo)

Acres 1/10 Safe Drinking Water Inlet (location)

Recommendations Make road impossible to 4-wheel vehicles.

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Remarks _____

Depth measurements, ten at equal distance north to south and 10 equal distance east to west

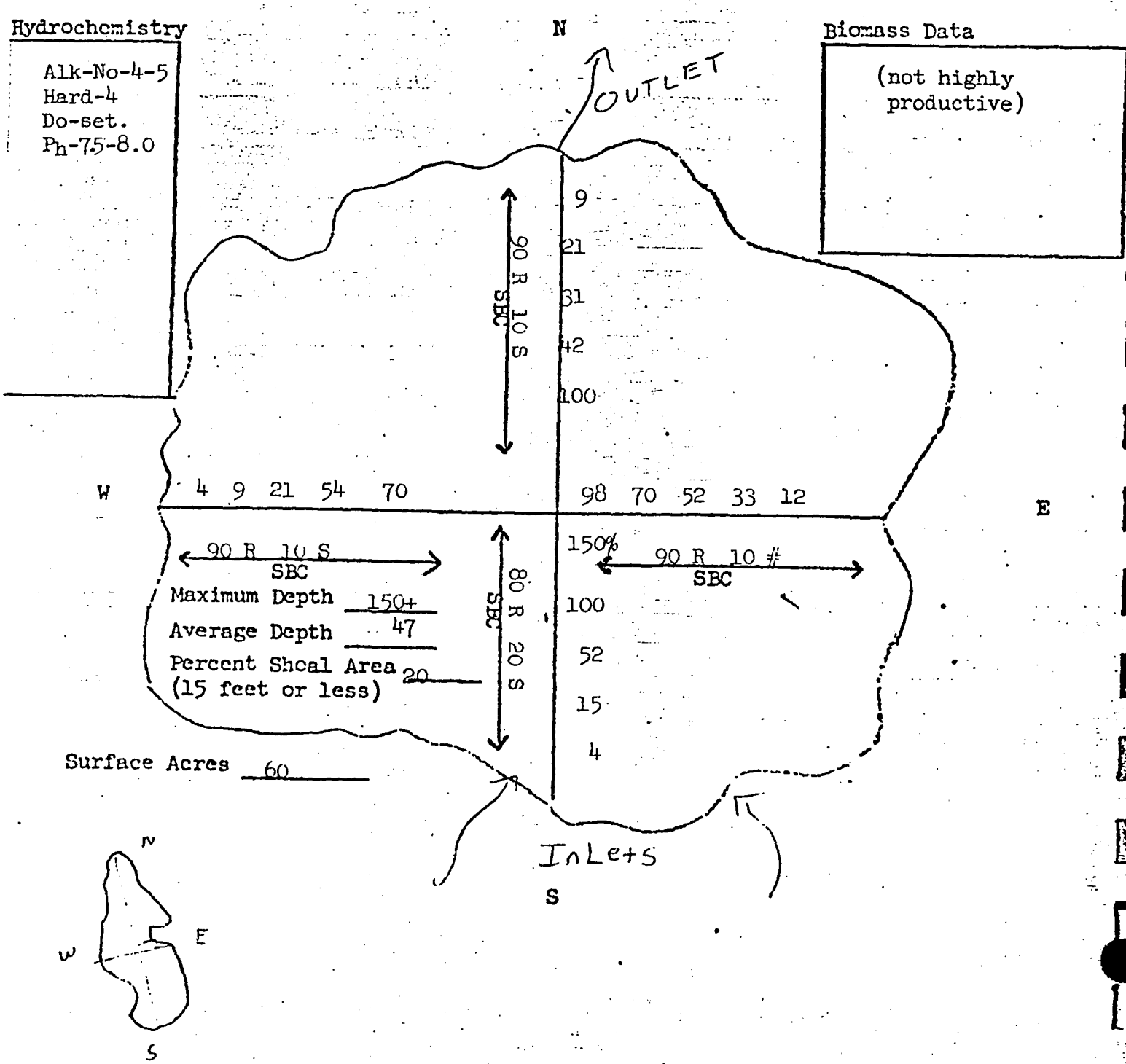
Shoal bottom composition transects (SBC) Percent bottom compositions from bank to loss of bottom vision

Hydrochemistry

Alk-No-4-5
Hard-4
Do-set.
Ph-7.5-8.0

Biomass Data

(not highly productive)



Examiner(s) /s/ Roy Hedden